DECEMBER 1, 1961

AUTOMOTIVE INDUSTRIES

ENGINEERING · MANAGEMENT · PRODUCTION · DESIGN

A CHILTON PUBLICATION

GM METHODS

At Work...SEE PAGE 37

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CHRYSLER'S ALUMINUM CYLINDER BLOCKS

POWER HAND TOOLS IN AUTOMOTIVE ASSEMBLY

LOS ANGELES SAE NATIONAL MEETING

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General Mgr. of Chevrolet

Elliott M. Estes
Vice President and General Mgr. of Pontiac

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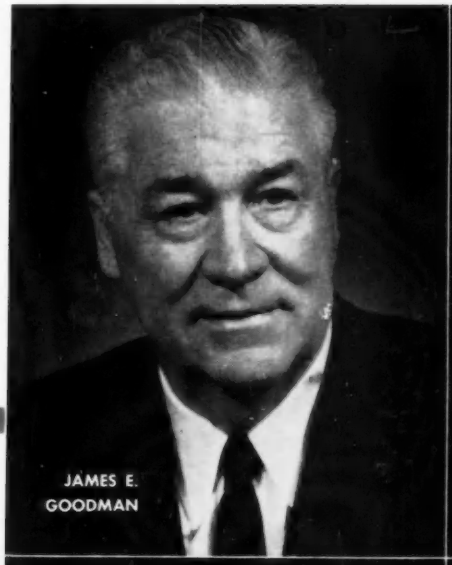
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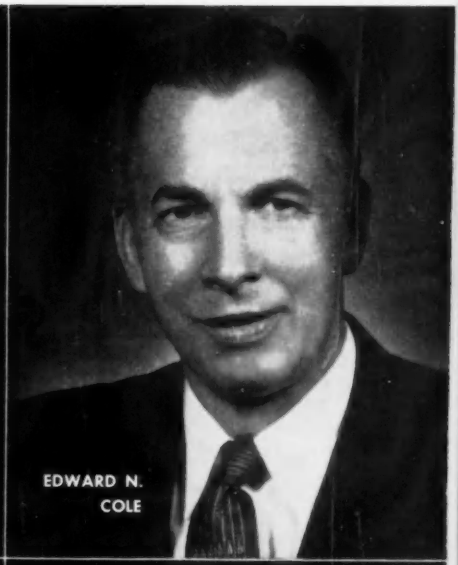
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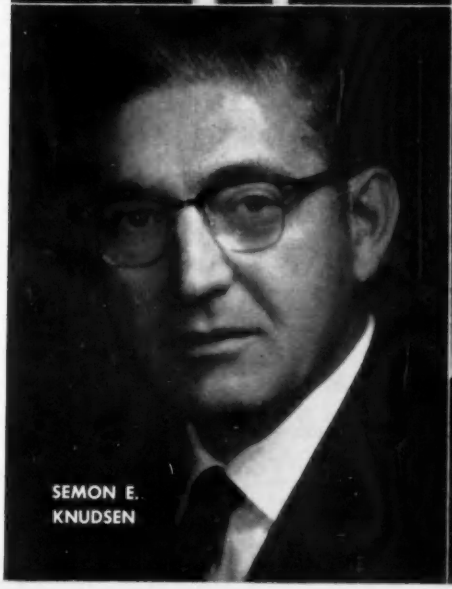
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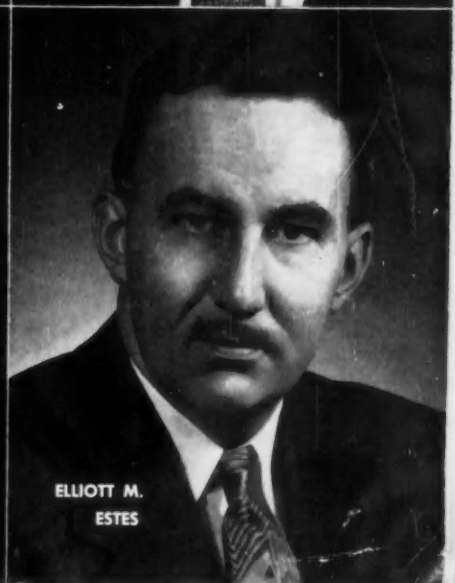
ELLIOTT M. ESTES

250,000 full turns, more than a lifetime of service, and the amount of wear on ratchet drive lugs, or tangs, is practically unnoticeable. Corners remained sharp and clean and the surface unmarred.

What kind of steel does New Britain specify for these vital parts? What kind of steel offers this combination of high torque strength, high surface resistance to wear and Brinelling, plus uniform machinability? An alloy steel, of course . . . Aristoloy 4150 to be specific.

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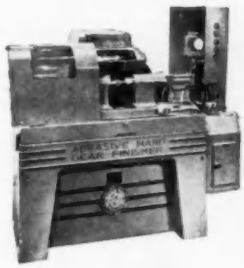
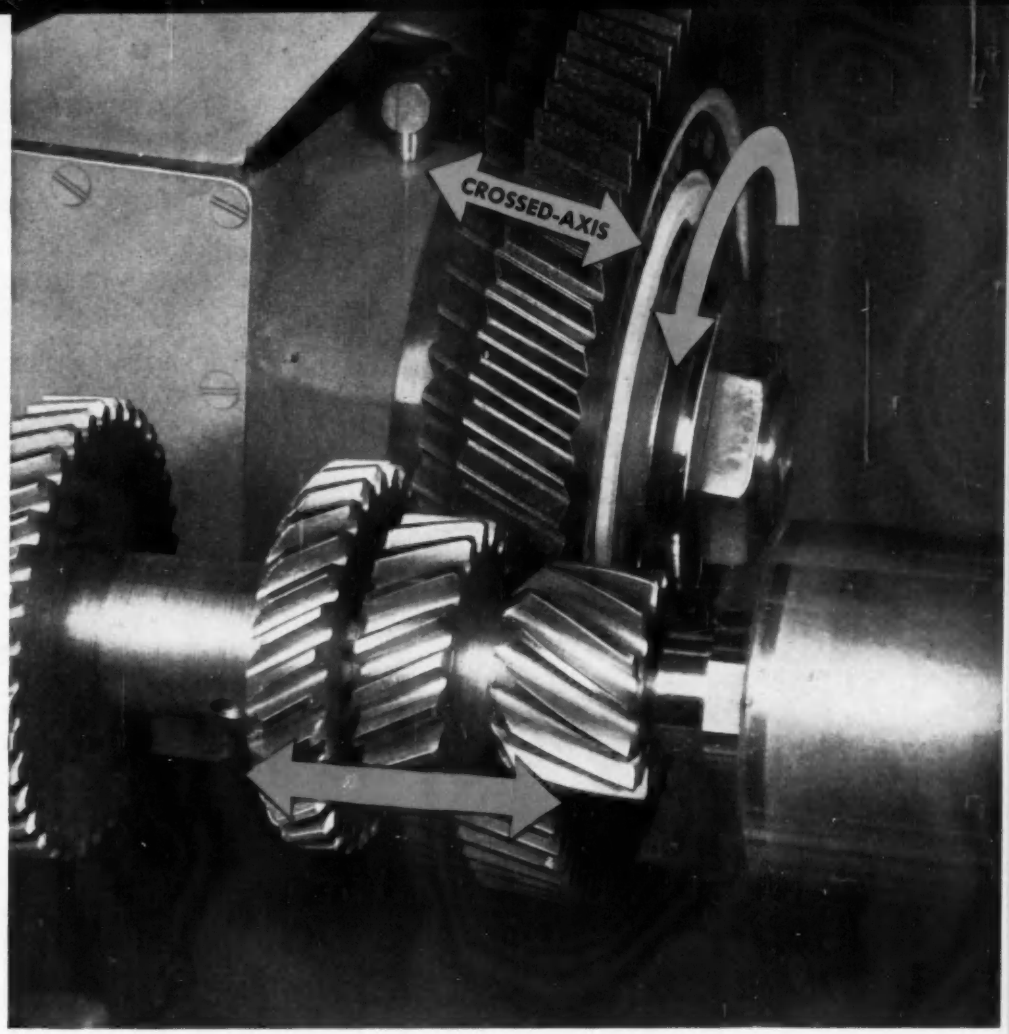


FOUR-MOTION GEAR FINISHING PROCESS GIVES...



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Smooth hone may be used to finish OD's in certain applications.

The new Michigan 999-A Abrasive Hard Gear Finisher uses four separate but integrated motions to give better surface finish on hardened gears and cylindrical parts. Nicks, burrs, some errors in lead and runout, involute, etc. are quickly corrected with newly developed hones of high-strength plastic available in a wide range of abrasives.

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4 built-in operating economies... built in with a Nickel cast iron block

Many fleet operators know from experience that the 400-series Mustang engines used in White trucks have four desired and important built-in operating economies.

The most important is the day-in, day-out fuel economy associated with high compression and light engine weight. The other three... reduced maintenance, reduced roadside repairs, reduced parts replacement... are associated with the remarkable ability of the Nickel cast iron block to resist heat, wear, shock, corrosion and other common "block buster" forces.

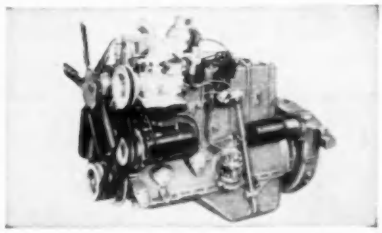
All four of these operating economies depend not only on basic design but also on the use of Nickel cast iron for the block. Here's what Nickel cast iron contributes.

Extra strength! Nickel cast iron gives the light, "pillar-type" Mustang block the extra strength needed for long, reliable heavy-duty service.

Extra pressure tightness! With Nickel cast iron the complex block can be reliably cast with the pressure tightness needed in these high compression engines.

Extra wear resistance! Nickel cast iron permits the improved hardness needed to resist wear in this powerful engine.

Extra resistance to impact, thermal shock! Nickel cast iron provides all-around better physical properties... boosts life.



From the engine builders' viewpoint . . . the use of Nickel cast iron is equally important. Nickel improves both the castability and machinability of irons... greatly simplifies foundry control over desired properties. If you buy or build internal combustion engines, look into the advantages of Nickel iron castings . . . for blocks, heads, flywheels, cam shafts, manifolds and other parts. Write for Inco's helpful "Engineering Properties and Applications of Nickel Cast Iron."

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DECEMBER 1, 1961

Passenger Cars • Trucks • Buses • Aircraft • Tractors • Engines • Bodies • Trailers • Road Machinery • Farm Machinery • Parts and Components • Accessories • Production and Processing Equipment • Design • Production • Engineering • Management

VOL. 125, No. 11

Features • • •

▼ General Motors Methods at Work

The evolution of "team methods" for improvements in production operations has become a significant advance at General Motors Corp. To illustrate and describe the methods, an example has been selected which represents a cross section of the kinds of methods typical of the whole company. Page 37

▼ Power Hand Tools in Automotive Assembly

A system for measuring the performance of power wrenches and screwdrivers is in operation at Chrysler's Newark, Del., assembly plant. The program is geared to bring out any evidence of tool deficiency before it could show up as an influence on production demerits. Page 43

▼ Forging Operations at Eaton

Exploration of new ideas in forging methods and equipment, and introduction of automated devices where justified economically, are among the keys to progress at the Marion Division, Eaton Mfg. Co., Marion, Ohio. This operation serves all Eaton divisions, as well as other companies; also supplies brake assemblies to makers of heavy duty vehicles. Page 48

▼ How Chrysler Makes Aluminum Cylinder Blocks

Although Chrysler Corporation has been producing die cast aluminum cylinder blocks for over 18 months, little information has been available on details of the technique. An illustrated article describes Chrysler's methods for making these components. Page 51

▼ SAE Aeronautic and Space Engineering Meeting

The SAE came up with a very interesting program at the national meeting, covering such subjects as: unconventional metal removal; electron beam welding; economic factors in the selection of material; and ground support equipment. Page 54

▼ 14 New Product Items, and Other Features, Such As:

News of the Machinery Industry; Industry Statistics; and News of the Automotive and Aviation Industry.

. . . continued on next page

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AUTOMOTIVE INDUSTRIES is a consolidation of The Automobile (weekly) and the Motor Review (weekly) May, 1902; Dealer and Repairman (monthly), October, 1903; the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

EDITORIAL EXECUTIVE OFFICES, Chestnut and 56th Sts., Philadelphia 39, Pa., U. S. A. Cable address—Autoland, Philadelphia.

AUTOMOTIVE INDUSTRIES. Published semi-monthly by Chilton Co., Chestnut & 56th Sts., Phila. 39, Pa. Second Class Postage Paid at Philadelphia, Pa. Subscription price: To manufacturers in and suppliers to the automotive industries in the U. S. & U. S. Possessions, $2.00 per year; $3.00 for 2 years. Canada, $5.00 per year. All others $10.00 per year. Single copies 75¢. Statistical Issue and Products Guide Issue $2.00 each net. Machine Tool and Production Equipment Issue and the National Auto Show Issue, $1.50 per copy net. Back issue prices on request.

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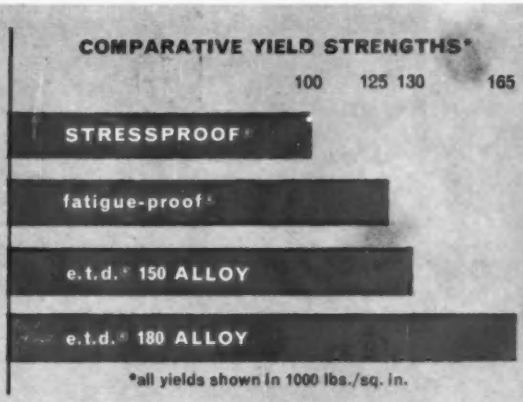

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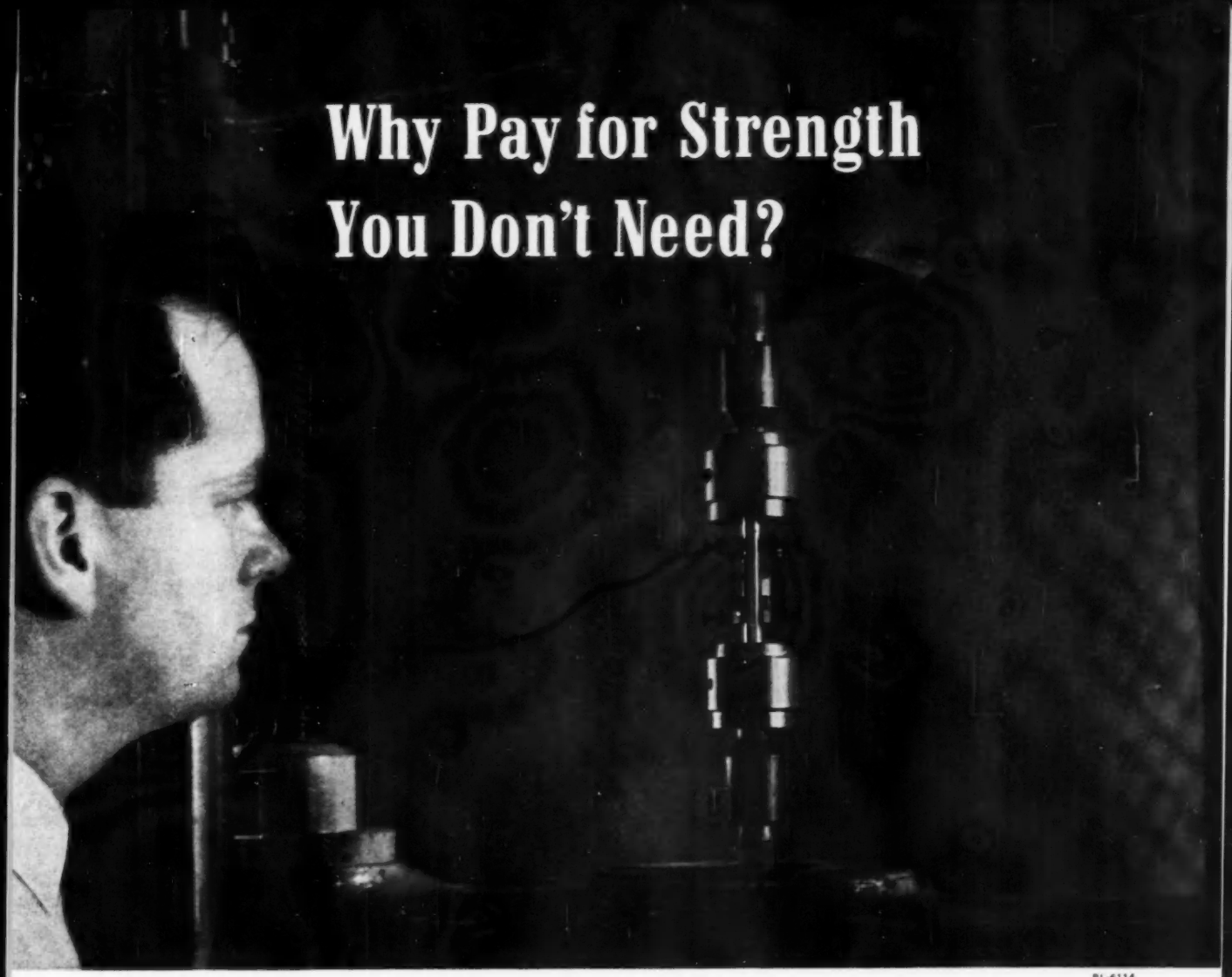

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OF COMING SHOWS AND MEETINGS

The Society of the Plastics Industry, Inc., 9th Plastic Film, Sheeting and Coated Fabrics Conference, New York City .....Dec. 7-8

Metal Cutting Knife Association, Annual Meeting, Pittsburgh ....Dec. 19

Society of Automotive Engineers, 1962 Automotive Engineering Congress and Exposition, Detroit.Jan. 8-12

52nd National Motor Boat Show, New York .....Jan. 13-21

National Plant Engineering and Maintenance Show, Philadelphia Jan. 22-25

American Society of Mechanical Engineers, 2nd Symposium On Thermophysical Properties, Princeton, N. J. .....Jan. 24-26

National Forum on Automotive Air Conditioning, Automotive Air Conditioning Association, Dallas Jan. 25-26

Automotive Accessories Manufacturers of America Exposition, Chicago .....Jan. 29-Feb. 1

Society of Plastics Engineers, 18th Annual Technical Conference, Pittsburgh .....Jan. 30-Feb. 2

The Society of The Plastics Industry, Inc., 17th Reinforced Plastics Division Conference, Chicago..Feb. 6-8

The Material Handling Institute, Inc., The Industrial Truck Association, Monorail Manufacturers Association, Early Spring Industry Meeting, Atlanta, Ga. ....Feb. 6-8

Malleable Founders Society, 7th Annual Technical and Operating Conference, Cleveland ..Feb. 28-Mar. 1

Motor and Equipment Manufacturers Association, and Automotive Service Equipment Association, 1962 International Automotive Service Industries Show, Chicago Feb. 28-Mar. 3

Society of Automotive Engineers, Automotive Week, Combined National Automobile and Production Meetings, Detroit .....Mar. 12-16

Instrument Society of America, 12th Annual Conference for the Iron and Steel Industry, Pittsburgh Mar. 14-16

4th National Chemical and Petroleum Instrumentation Symposium, Instrument Society of America Apr. 9-10

American Welding Society, 43rd Annual Convention and Welding Exposition, Cleveland .....Apr. 9-13

American Society for Metals, Regional Conference and Exhibition, Materials and Materials Processing for the Petroleum, Petrochemical and Chemical Industries, Houston, Texas .....Apr. 17-19

6th Annual Automobile Show, New York .....Apr. 21-29

Western Space Age Industries and Engineering Exposition and Conferences, San Francisco .....Apr. 25-29

Design Engineering Show, Chicago Apr. 30-May 3

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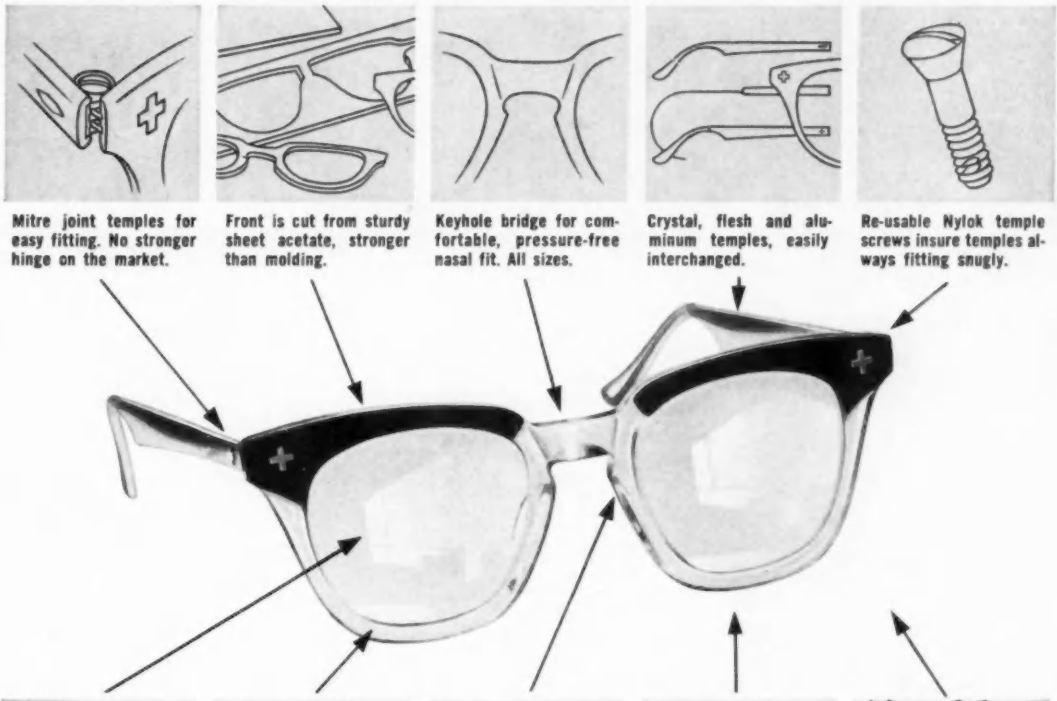

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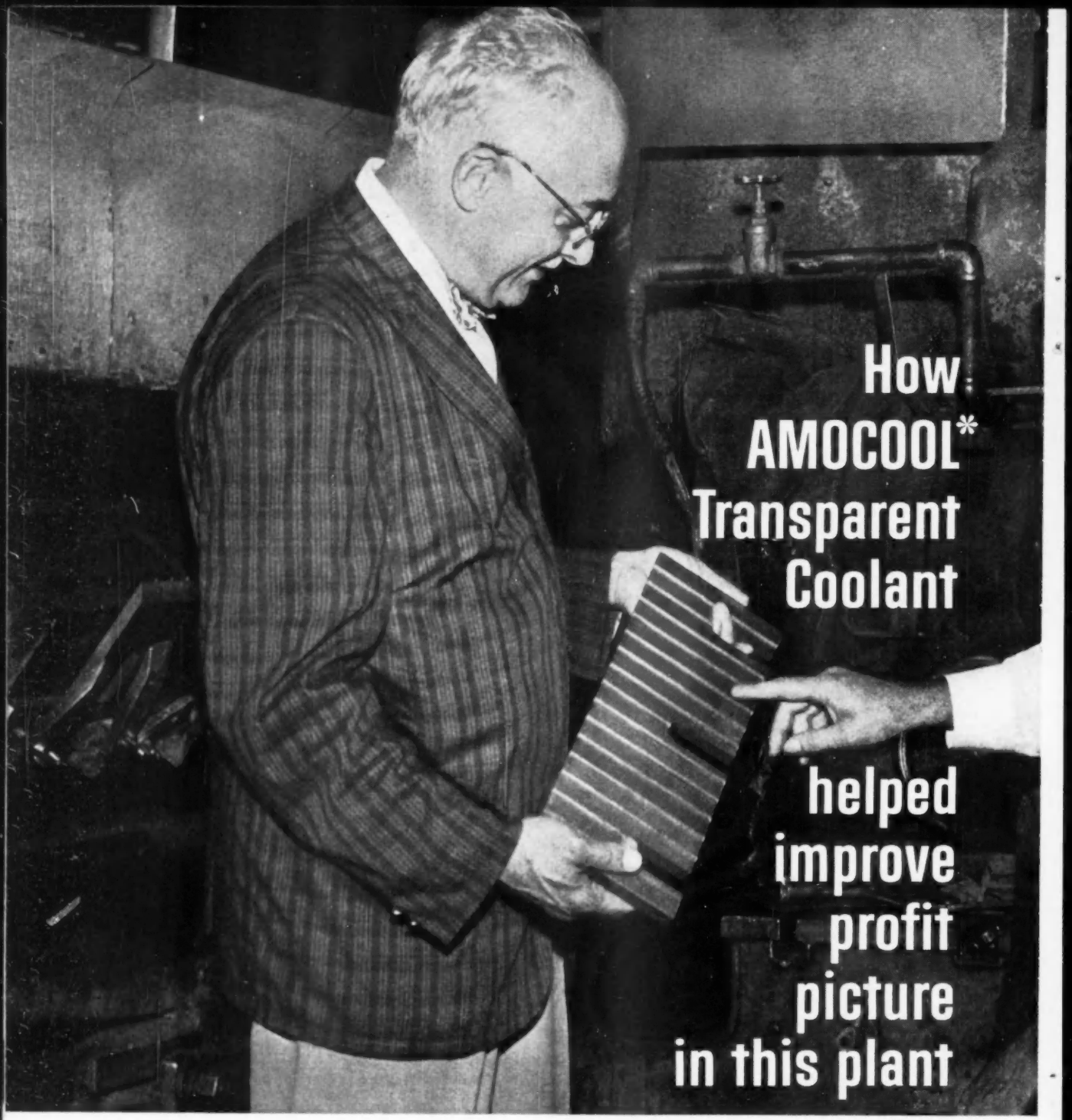

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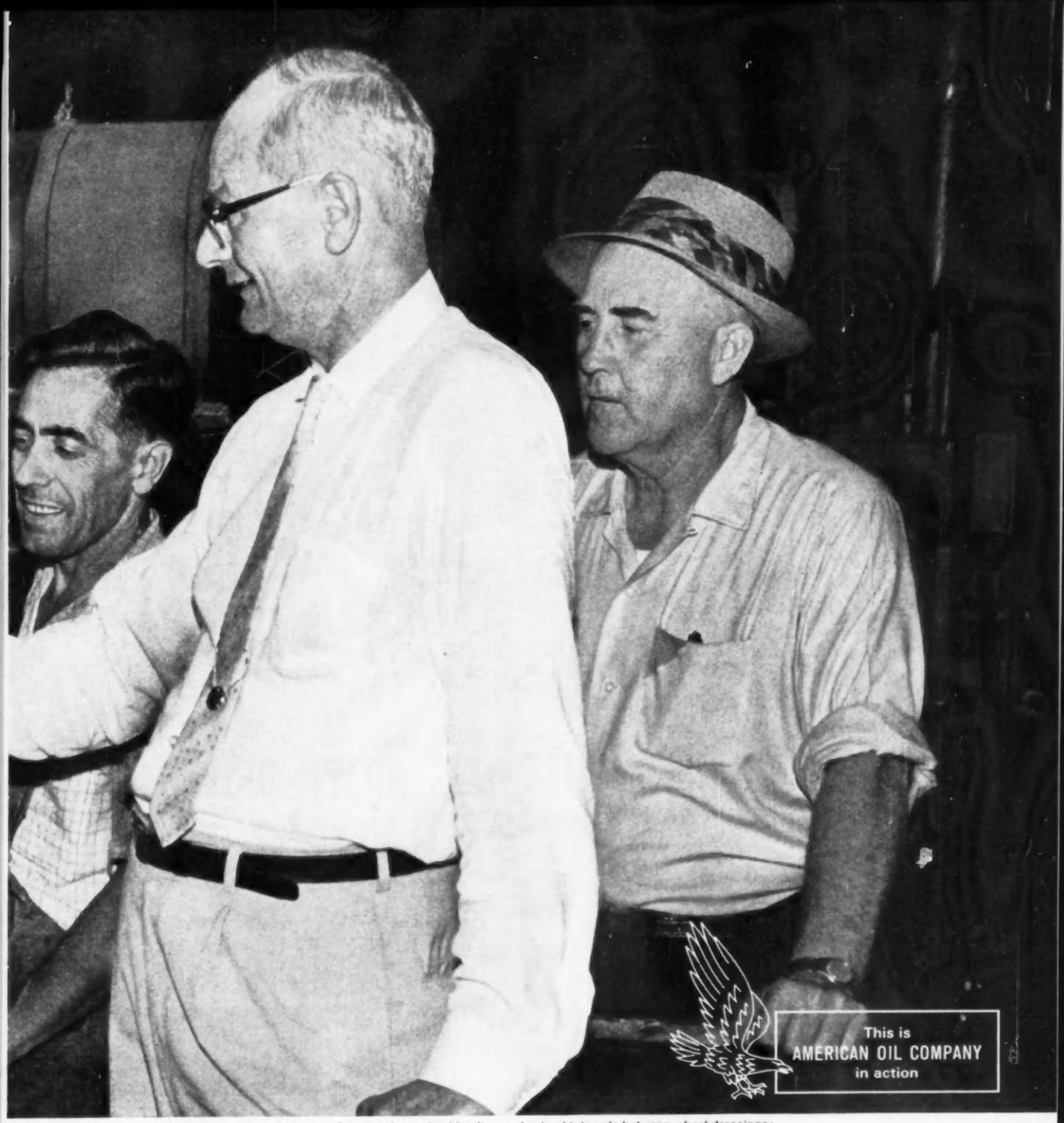
BY PAUL E. "PAPPY" STRATTON

About the Author. "Pappy" Stratton has been providing technical help on lubrication and metalworking problems to customers in the Detroit area for nearly all of the twenty-five years he has been working for the company. In addition to having this store of practical experience to help him, Pappy has completed the Company's Sales Engineering School.

By using a soap-base grinding compound, Detroit Edge Tool Company was getting excessive corrosion and rust on work and grinding machines. Oil vapor was collecting on machines and on the ceiling, causing dirty working conditions. Most important, high wheel loading was causing frequent down-time for wheel dressings.

We worked out a test program on AMOCOOL Transparent Coolant with the management. On our first test on one surface grinder, feed pressure was cut substantially while at the same time metal removal was increased.



Eliminate reworking because of rust, reduce wheel loading and extend intervals between wheel dressings; do these and you increase profit per unit, explains Detroit Edge Tool president, Dan Ebbing, to P. E. "Pappy" Stratton of American Oil. Plant manager, John Yonker (right) and Sam Vineh, operator, look on.

The cost of reworking parts to remove rust was eliminated. Time required to clean machines to get rid of the odor was cut in half. Less wheel loading and fewer wheel dressings have upped production and reduced costs. Our test program paid out in an improved profit picture. All grinding and drilling equipment has been converted to AMOCOOL Transparent Coolant.

Would you like this kind of technical help to assist you in improving profits? Get it by calling the American Oil Company office nearest you.

Quick facts about
AMOCOOL
Transparent Coolant

- Clear, transparent fluid
- Controls corrosion on work and machines
- All chemical. Does not support bacteria growth
- Unaffected by humidity
- Fire resistant
- Odorless

AMERICAN

AMERICAN OIL COMPANY
910 South Michigan Avenue
Chicago 80, Illinois

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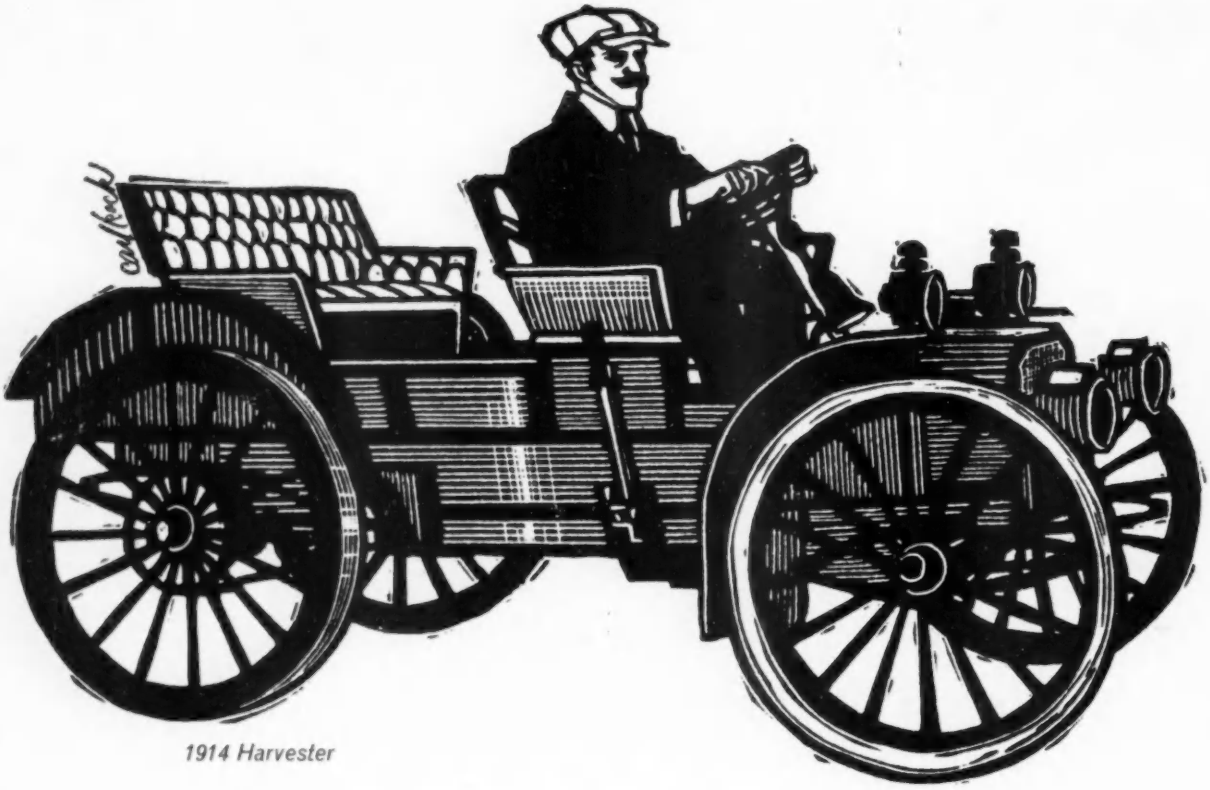

1914 Harvester

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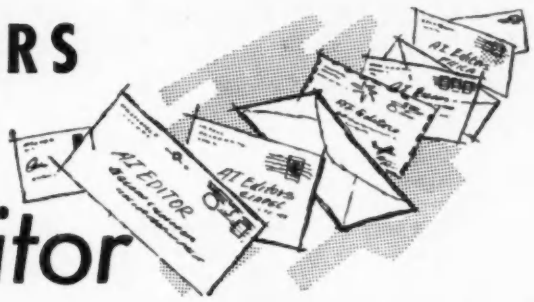
LETTERS to the Editor



Readers' opinions or requests for additional information on material appearing in the editorial pages of AUTOMOTIVE INDUSTRIES are invited for this column. No unsigned letters will be considered, but names will be withheld on request. Address *Letters to the Editor*, AUTOMOTIVE INDUSTRIES, 56th & Chestnut Sts., Philadelphia 39, Pa.

PLASTICS SERIES

Your report, "Plastics, Part III," was more up to date, concise, and comprehensive from a production viewpoint than is generally available in plastics periodicals. These articles are of value because they introduce new materials and production concepts which may be used for cost reduction and improvements of electronic products.

It is with interest that I anticipate reading your future special reports on plastics in AUTOMOTIVE INDUSTRIES magazine.

John F. Schroepfer
Process Engineer
Ryan Electronics
Division of Ryan Aeronautical Co.
San Diego, Calif.

A.I. AT WORK

In your September 1 issue of AUTOMOTIVE INDUSTRIES, there is, on page 84, a picture and article on a Gilman 16-Station 6 in. Transferline Assembly Machine.

Would you be so kind as to forward our request for a brochure or other descriptive literature to these people?

We manufacture automotive electrical replacement parts, and feel that perhaps this type of equipment could be applicable in our plant.

K. Y. Lovegren
C. E. Niehoff & Co.
Chicago, Ill.

● *Happy to oblige—Ed.*

NICKEL

An Austrian steel mill asked us to obtain for them one copy of the following publication: "The Use of Nickel - Containing Materials in the Automotive Industry" by A. W. Shearer, ASTM 1959, Tentative 67.

The American Society for Testing Materials, as well as the SAE, informed us that they were unable to identify it as being one of their publications.

We wonder now whether such an article perhaps was published in one of your issues.

Ingeborg R. Berenter
The Austrian Trade Delegate
New York, N. Y.

● *Pleased to forward tearsheets of the article you requested—Ed.*

PURCHASING PRACTICES

Very interested in reading your November issue article on Purchasing at Chrysler.

If you still have four re-prints of this article available, I would appreciate receiving them from you.

G. J. Haislmaier
General Sales Manager
Automotive & Industrial Div.
Modine Manufacturing Co.
Racine, Wis.

We wish to request a copy of the article, "Inside Purchasing at Chrysler Corporation," which appeared in the November 1 issue of AUTOMOTIVE INDUSTRIES.

We find this article very informative and of much assistance to us. We wish to place this in our files.

Boyertown Auto Body Works
Boyertown, Pa.

PLAUDIT

Your October 15th new model issue is the best ever—informative, colorful and really outstanding.

Congratulations!

Van Buren Thorne, Jr.
Director of Public Relations
General Motors Acceptance Corp.
New York, N. Y.

think again

If you think that fasteners are "chicken feed", think again. Your costs mount up when you use faulty fasteners that slow down and stop assembly operations, or cause damage to materials and tools.

Why not buy quality fasteners in the first place, and then your fastener costs will really be "chicken feed".

Order Southern Screws from your distributor, or write direct to Southern Screw Company, P. O. Box 1360, Statesville, North Carolina.

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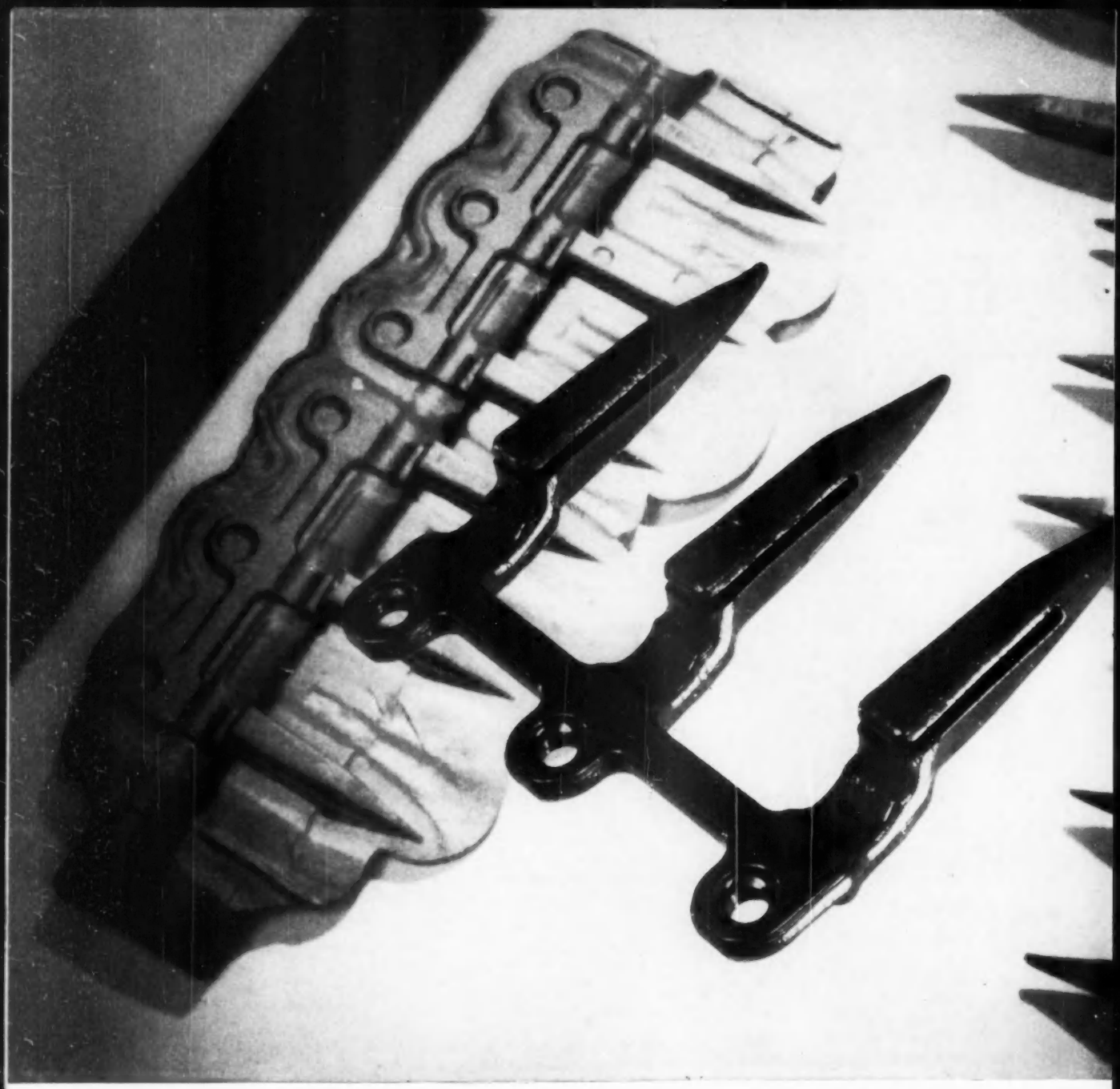

ANGLES CHANNELS TEES HEXAGONS ROUNDS HALF ROUNDS

United States Steel offers the widest range of carbon and alloy bar sizes, shapes and grades available in the industry.
We're a single source for all your requirements.

Sickle guard forged from USS Bar Stock for longer life

This forged and machined part will last longer than the cast design it replaced even though it weighs 12% less and costs less. It's a sickle guard used on the cutting platform of a line of John Deere self-propelled combines, and is manufactured by Buchanan Steel Products Corporation, Buchanan, Michigan.

John Deere wanted the part to be thinner for maximum cutting coverage at high speeds, and shock- and wear-resistant so that it could self-sharpen the blade. The designers specified forged steel because it would mean a lighter, tougher, more durable part. The part is forged from bar flat steel produced by United States Steel.

Design and fabrication possibilities are virtually unlimited with USS Carbon and Alloy Bar products. Forgings are usually fabricated from USS flats, rounds or round-cornered squares. And nowhere else can you get the range of sizes, shapes and grades offered by USS. You name it —we have it. Just call our nearest sales office, or write United States Steel, Room 6326, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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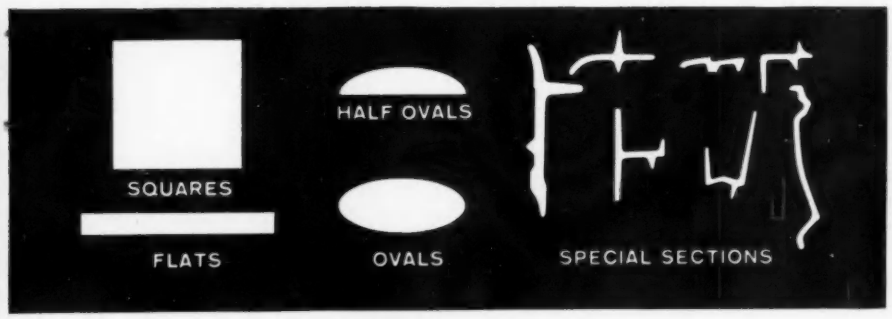
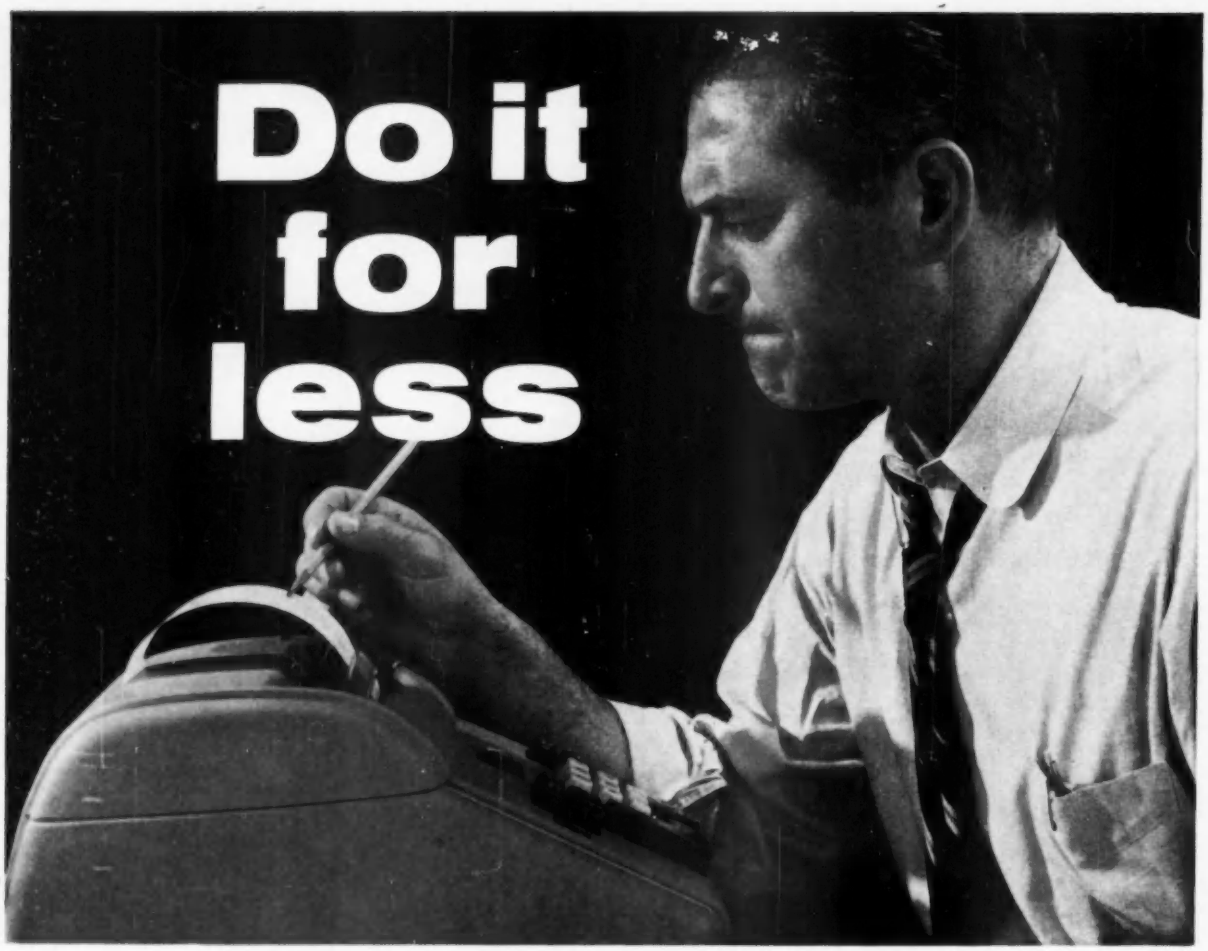
This mark tells you a product is made of modern, dependable Steel



USS United States Steel

TRADEMARK



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Vertical or horizontal models for light-weight, high-speed parts.

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Fast setup . . . easy calibration . . . complete plane separation . . . no special foundation or location required.

Gisholt has the largest line of production-proven balancers in the world . . . from which you can select the machine that best meets your needs.

Contact your Gisholt Representative or write for Catalog 1109D.

You trust an adding machine . . . it cannot err if the correct keys are punched. Balancing is different. You can go through all the correct motions and still come up with the wrong answers . . . *if* your equipment makes you rely on operator skill and judgment to determine unbalance angles and amounts.

Gisholt Balancers eliminate operator "guessing". Setup is fast . . . exact angles and unbalance readings in terms of actual correction methods used, are obtained electrically in 15 seconds or less. Integral correction equipment can be added to correct and inspect in the same handling.

Don't let product quality and production efficiency depend on operator judgment. Learn how the accuracy, efficiency and *reliability* offered by Gisholt Balancers can help you do it for less.

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MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

Turret Lathes • Automatic Lathes • Balancers • Superfinishers • Threading Lathes • Factory-Rebuilt Machines with New-Machine Guarantee

... Results of a Superior Beginning

The countless parts and products made from Roebling high-carbon steel spring wire and flat spring steel have one thing in common . . . their superior quality. This, of course, is related to the inherent fineness of the materials.

The variety in which Roebling offers these spring materials is equally impressive. They are available in hard drawn, hard rolled, annealed or soft, tempered or untempered. Types include zigzag and no-sag wires; upholstery and mechanical spring wires; valve spring wire; clock- and motor-type spring steels and flat spring steels of all types and description.

Whatever the type, size or characteristics you require — Roebling can fit your needs exactly. You'll find that Roebling quality means maximum production from your machines and consistent uniformity in your product.

For spring wire and flat spring steel information, contact Roebling's, Wire and Cold Rolled Steel Products Division, Trenton 2, New Jersey.

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Cars run "cotton quiet" with timing gears molded from Celoron® by C. D. F. Celoron's macerated cotton fabric base provides the low natural tone frequency needed to minimize the sounds of the timing drive. Along with its advantages in sound harmonics, Celoron—a molded phenolic—endows gears with vital qualities of high tooth strength and great resistance to impact and high temperatures.

Another example of how C. D. F., with its broad range of materials and production facilities, serves the automotive industry!

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NEWS

Vol. 125, No. 11 December 1, 1961

4 Promotions at GM

Goodman, Cole, Knudsen, Estes Advanced

By James Dunne, Detroit Regional Editor, and C. B. Campbell, News Editor

Four promotions of General Motors Corp. executives have resulted from the retirement of Sherrod E. Skinner as executive vice president.

Replacing Mr. Skinner is James E. Goodman, 56, veteran vice president and group executive, who was elected an executive vice president.

Edward N. Cole, 52, vice president and general manager of the Chevrolet Div., was named a director and group executive in charge of the car and truck divisions group. He also was named a member of the executive committee.

Knudsen Transferred

Semon E. Knudsen, 49, vice president and general manager of the Pontiac Div., was named general manager of Chevrolet.

Elliott M. Estes, 45, chief engineer at Pontiac since 1956, was promoted to vice president and general manager of Pontiac.

Mr. Goodman, who began with GM 36 years ago as a production worker in a Fisher Body plant, had headed the Buick-Oldsmobile-Pontiac Assembly Div. and the Fisher Body Div. for the last three years.

Mr. Cole and Mr. Knudsen were expected to be promoted because of the sales gains shown by Chevrolet and Pontiac during the five years they headed those divisions.

Both are regarded as top candidates to succeed President John F. Gordon when he steps down four years hence.

Mr. Cole's new duties are about the same as those Mr. Gordon had prior to his election to the GM presidency in 1958. Mr. Knudsen is the first executive in recent years who has headed more than one car division during his GM career.

His father, the late William S. Knudsen, former GM president, at one time managed the combined operations of Chevrolet and Pontiac.

In the GM organization, the four executive vice presidents are directly under Chairman Frederic G. Donner and Mr. Gordon.

Group executives, of whom there also are four, are next in command. They outrank staff vice presidents and division general managers.

NEW DODGE POLARA FOUR-DOOR HARDTOP

This is the latest model Dodge is adding to its Polara 500 line. It is powered by a 361 cu in. displacement, 305-hp V-8 engine as standard equipment.

New Jaguar Top Model at London Show; U. S., Canadian '62 Sales Seen Doubled

By David Scott
British Correspondent

Biggest attraction at the London Motor Show undoubtedly was the Jaguar Mark X, on view for the first time. Widely regarded as one of the most handsome European cars ever built, it is moderately priced for a luxury sedan in the high-performance class.

As a result, the company had orders for 4000 from its U. S. and Canadian distributors, part of a $63 million deal concluded during the first days which will double its North American sales next year. This will account for three months' output for this model when the production target of 300 daily is reached in early 1962.

Strong Basic Structure

The Mark X is of unitary design with stressed wheel arches and other internal panels integrated with two large box-section sills to form an extremely strong basic structure that does not rely on the roof for stiffness. Jaguar claims the shell is far more rigid than that obtained from a separate body and chassis construction of equal weight.

An unusual aspect of the front suspension is the forged I-beam cross-member which carries the coil spring assemblies at its extremities. Used in place of a welded sub-frame, it is rubber-mounted on the body.

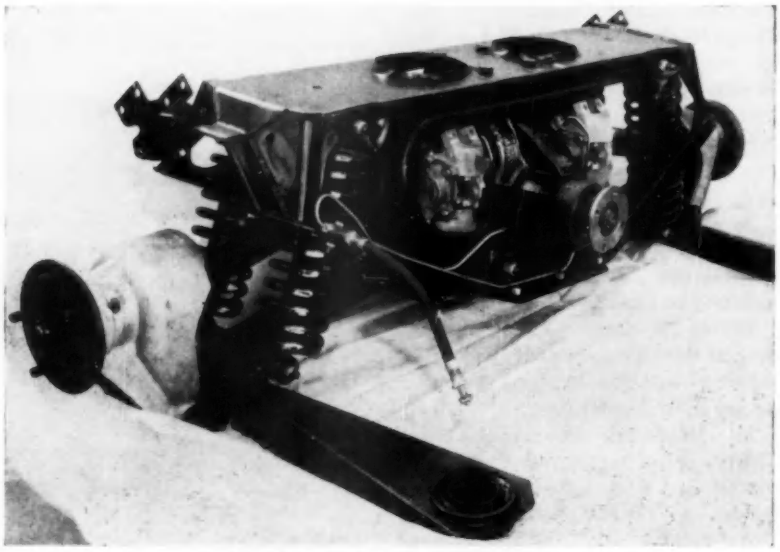
The independent rear suspension with a pressed steel frame is derived from the E-Type sports car. Each wheel is supported by a swinging half-shaft paralleled by a tubular lower link that pivots on the wheel carrier sprung by twin coils. Longitudinal location is by a rubber-bushed trailing arm.

3 Optional Transmissions

The XK "S"-type twin overhead-camshaft engine of 230.6-cu in. displacement develops 265 hp at 5500 rpm. Optional transmissions are manual, overdrive and automatic. Power steering is standard, and the vacuum-assisted brakes have separate hydraulic circuits for front and rear wheels as a safety measure.

Second largest crowd-gatherer at Earls Court was probably the Vauxhall Victor VX/90, a tuned-up edition of the new Victor intro-

Forward-Raked Front End of Jaguar Mark X



New Jaguar's Rear Suspension

duced in September. This follows the policy of the British Motor Corp. and other manufacturers of offering higher-powered, "luxury" versions of basic four-cylinder models.

Output of the Victor 79.8-cu in. engine is increased by 44 per cent to 81 horsepower. Main changes are a light alloy cylinder head, twin Zenith carburetors on a water-heated manifold, compression raised to 9.3, and a modified camshaft.

Larger Clutch Installed

A larger 8-in. clutch is used to handle the greater torque, followed by a four-speed all-synchromesh gearbox with remote floor-mounted lever. Lockheed 10½-in. disk brakes are fitted in front, accommodated within 14-in. wheels that replace the 13-in. ones on the standard Victor.

English Ford's new offering, the Consul Classic Capri, follows the Continental trend of adapting a coupe hardtop to an existing body hull to make a "personal" car. Contoured bucket seats and heavy carpets are among interior appointments.

But the local price of the Capri is high for what is virtually a non-sports two-seater. This is explained in part by the fact that the body is produced by Pressed Steel, a B.M.C. subsidiary, since Ford's own press and welding facilities are working to capacity.

Ford also presented the 105E Anglia station wagon, which breaks with Ford's practice of deriving its smaller wagons from panel trucks. The two-door has a fully furnished interior with top-hinged tailgate

GM's Vauxhall Victor VX 4/90 Has Dual Carburetors

Riley Elf Has Transverse Engine Driving Front Wheels

Aston Martin DB.4 Has Maximum Speed of 140 MPH

NEWS

CONTINUED

giving access to the cargo area that is extended to 35 cu ft when the rear seat is folded.

B.M.C. face-lifted most of its sedans for the show, and added further models under new guises. Engine displacement of the 1.5-liter Austin, Morris, MG Magnette, Riley and Wolseley is increased slightly to 99 cu in., although gross power of the single-carburetor units is up substantially from 55 to 63 hp as a result of altered head design.

Most important innovation on these cars is the availability of the new Borg-Warner Model 35 automatic transmission, which can be installed without altering the floor pressing, strengthening the front suspension, or incurring a weight penalty.

More Leg Room

Tread and wheelbase of the above models (except the MG and Riley) are extended by two and one in. respectively, giving a bit more leg and hip room in the rear. At the same time, overall length is reduced by 4 in. by flattening and recessing the bumpers. Tail fins are moderated to taper the profile.

On the larger six-cylinder cars, now designated Austin A.110 and Wolseley 6/110, wheelbase is stretched 2 in. to eliminate intrusion of the rear wheel arches, while the 177-cu in. power unit is modified to deliver 120 hp. Both power and wheelbase are increased on the Austin A.40.

B.M.C. is cashing in on the inverted prestige value as well as sporting appeal of its successful transverse-engined ADO.15 Austin and Morris minicars by producing variants called the Wolseley Hornet and Riley Elf. Mechanical specifications are unchanged, but the trunk is enlarged to stretch overall length to 129 in.

Austin A.60 Cambridge Has Larger Engine

Lagonda Rapide Capable of 125 MPH

Hillman Super Minx

Rootes featured the new Hillman Super Minx, which uses a similar body and running components to the costlier Singer Vogue released in July. About 2 in. longer and wider than the previous Minx which continues in production, it is built on a 101-in. wheelbase. Engine is a 97-cu in. unit with a 66-hp gross rating at 4800 rpm.

While the Triumph TR.4 had made its debut at Frankfurt, it was one of the stars at the London show. Stated to be the best-selling British car in America, this latest successor to a long line of sports cars has been completely restyled by Michelotti of Turin and is likely to continue as the export mainstay of Standard-Triumph.

Among the specialist auto manufacturers in the higher-price field, Aston Martin presented its ultra-performance DB.4 sports model in four-passenger convertible form. Optionally available is a special cylinder head on the 223-cu in. six-cylinder engine which raises net output to 262 hp at 5500 rpm, and maximum torque to 240 lb/ft at 4260.

The company also displayed the Lagonda Rapide, a luxury four-door powered by the same engine in its 236-hp rating. Rear wheels on a de Dion axle are sprung by torsion bars, while coil springs are employed in front. An aluminum body cuts the weight to 3780 lbs.

Hughes 269A compact, low-cost helicopter, designed and mass-produced by Hughes Tool Co., Aircraft Division, Culver City, California, utilizes extrusions of rigid Geon manufactured by Ryko Products, Inc., Los Angeles. Portions of Geon extrusions are shown inset: ① aerodynamic shape is part of slat across cabin top; ② flat, notched sections contain and seal plastic canopy; ③ T-shaped section is part of tail boom spoiler. B.F. Goodrich Chemical Company supplies the rigid Geon vinyl resin.

Now even helicopters go "compact"– low-cost design features rigid Geon

The manufacturer of this helicopter had a special design problem: how to save weight and cost while meeting the tough design requirements of aircraft. Engineers found the answer in rigid Geon vinyl. Lightweight and accurate extrusions of rigid Geon helped keep costs down. At the same time, their strength and resistance to weathering made them structurally and aerodynamically ideal.

Rigid Geon vinyl extrusions are used to join—and seal—sections of the acrylic "bubble", as well as for door frame retainers. Other extrusions form the aerodynamic slat across the cabin top and the tail boom spoiler.

Here's another excellent example of the way that rigid Geon improves a product, reduces weight and costs. To get more information, write Department NP-6, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical

a division of The B.F.Goodrich Company

Geon VINYLS

Inventory Management Simulator program at...

Clark Equipment... improves customer

■ **High-capacity memory.** Two IBM 305 Data Processing Systems with RAMAC keep track of 75,000 replacement and repair parts in Clark's Chicago parts warehouse. ■ **The computer has the facts.** As soon as shipments arrive at the warehouse, an operator, using this remote inquiry station near the loading platform, finds out from the computers where various items go. ■ **Customer service first.** Using this remote inquiry station in the sales department, the operator gets information from the computer while the customer is on the phone.

Clark Equipment Company has prepared a computer program called an Inventory Management Simulator. The program allows Clark management to study the possible effects of decisions on future customer service and future warehouse profitability. When management gets the computer's report, it is in a position to make new rules for the operation of its parts warehouse.

Here's what's happened since Clark put the new program into operation:...improved customer service...practically eliminated back-order problem . . . reduced the putaway time for incoming material by more than 50 per cent . . . reduced emergency order shipping time by 50 per cent . . . enabled a physical inventory to be taken without any interruption of service to customers.

service...with less inventory

Availability highest ever. Inventory management is a complex job at Clark. Its Chicago warehouse is one of the busiest and largest in the country. Before the Simulator program was developed, the warehouse carried an inventory of 85,000 individual replacement and repair parts. Use of the program helped transfer the investment in inventory to those parts most frequently called for, giving high availability with less investment.

Management Operating System.* Clark installed two IBM 305 Data Processing Systems with RAMAC.® These computers store, update, and offer on an instant's notice information on almost every aspect of the warehouse operation including complete information on every one of the 75,000 items maintained in stock.

Now, Clark is assured of maintaining just the right level of stock for each item. The procurement formulas, developed from the Inventory Management Simulator, even recommend how large a purchase order should be placed for each item and where it should be placed.

If you have an inventory problem, why not consider a simulation program? You don't have to have your own computer. We can supply you with an Inventory Management Simulator...you can rent time on a computer. Result...improve the profitability of your warehouse operation.

**A Management Operating System uses IBM computers to make routine business decisions and take action automatically ...flags problems that need management's special attention... frees management to concentrate on the big problems and on long range planning. As a result, it gives tighter control of all business operations...and helps cut costs.*

IBM®
DATA PROCESSING

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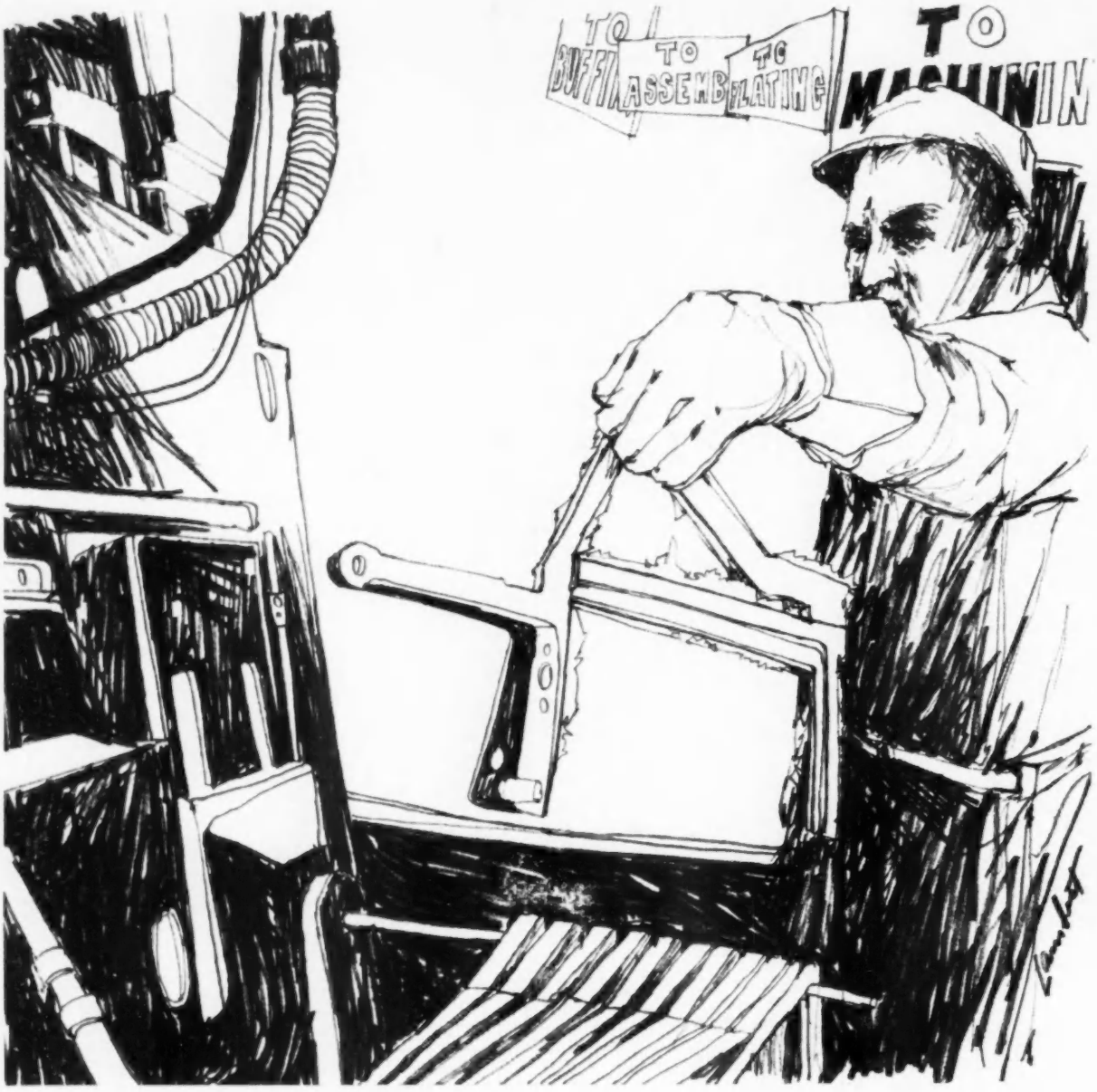

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We're die casters, of course. Biggest, best-equipped, most service-minded in the business. More facilities, more highly experienced personnel, the widest range of die-castable alloys, our own fleet of trucks to give overnight rush service when needed. When you want a part die cast, you can't do better than Doehler-Jarvis. *But that's not all!* If you're a cost-conscious purchasing agent or production man, consider the other advantages of using Doehler-Jarvis. We'll not only die cast the part you want, but drill it, tap it, ream it, buff it, degrease it, finish it (plate it, paint it, anodize it, or whatever), sub-assemble it, inspect it, package it and ship it. To you or direct to your distributors. The plant is ours, but the production line—from blueprint to final packaging—is yours. Chances are we can save you money every step of the way. Ask Doehler-Jarvis to quote on your very next job. Call or write the Doehler-Jarvis office or plant nearest you.

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NEWS

FEATURES

Chevrolet's Test Car

Rear Engine Model Weighs Only 1600 Lbs.

The auto industry's latest experimental vehicle, the CERV-1, has been built at the Chevrolet Engineering Center, Warren, Mich., as a research tool for continuous investigations into automotive ride and handling phenomena.

The car, a single passenger model, was a special project headed by Zora Arkus-Duntov, Chevrolet staff engineer and noted designer.

A fundamental factor in the design of CERV-1 is the visibility afforded by the body design. The streamlined body encloses the engine, transaxle, and engine cooling system and provides an open cockpit from which all four wheels are clearly visible.

Rear Mounted Engine

The driver sits well forward of the center line; all four wheels are independently suspended and the engine is rear mounted with a fully synchronized four-speed transaxle.

The model's wheelbase is 96 in.; it weighs approximately 1600 lbs, and the extremely stiff frame is of chrome - molybdenum steel tubes welded into a truss-like structure weighing approximately 125 lbs. Its overall length is 172 in., width is 52 in. and it is only 31½ in. high.

The lightweight body of about 80 lbs is aerodynamically styled and fully encloses the underside of the car. The body is made of a glass fiber-reinforced plastic, thinner than that used in the Corvette body.

Power for the experimental model is supplied by a special lightweight version of the Chevrolet 283 cu in. V-8 that develops 350 hp and weighs 350 lbs. Such output, only one lb per hp, is rarely achieved in reciprocating engines. Weight was reduced by using an aluminum cylinder block, cylinder heads, water pump, starter motor body, flywheel and clutch pressure plate. Magnesium is used for clutch housing and fuel injection manifold. By using aluminum and magnesium, more than 175 lbs were saved.

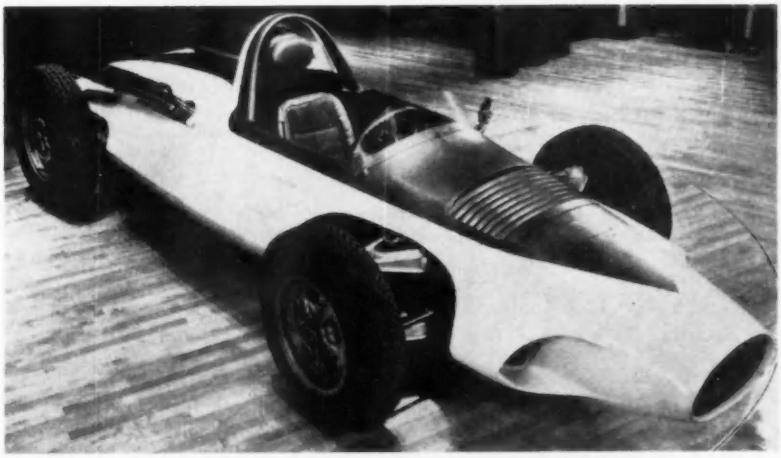
Other engine features include a special fuel injection unit, individual tuned exhaust pipes, no mufflers, no cooling fan, aluminum radiator mounted forward of the driver, and two oil cooler radiators, mounted one on each side of the radiator.

Power transmission to the wheels is completed through four axle shafts with universal joints on each end.

Variable rate coil springs and shock absorbers are used in both front and rear suspension. An 11/16th in. stabilizer bar inter-connects the front wheels.

Two 10-gal rubber cell fuel tanks are located on either side of the CERV-1.

Brakes are similar to the HD type on the Corvette. Sintered iron linings are used with fin-cooled drums.



Chevrolet's Engineering Research Vehicle

AI TABLOID

As insurance against destructive fatigue and shock, crankshafts of Diesel engines are made of ductile iron—a material that has the strength and flexibility of steel yet can be cast as easily as ordinary cast iron.

* * *

Motor fuel consumption is expected to total 64.9 billion gallons for 1961 in the United States, a gain of 2.6 per cent over 1960.

* * *

Production of the industrial heating equipment industry exceeded $300 million in 1960 for the first time since 1957. A survey revealed that output totaled $302.4 million, slightly less than the high of $307.8 million in 1957.

* * *

Soviet welding technology has made such remarkable advances since 1959 that the USSR's welding industry rates first place among European nations today, according to a Moscow technical journal.

* * *

A guide to the principal sources of scientific and industrial information in the U. S. is presented in a directory of Materials Information Centers. Compiled by the Air Force, the directory lists and describes more than 80 organizations including special libraries, trade organizations and government facilities engaged in the collection and dissemination of technical information.

* * *

Titanium carbide and cobalt alloy ball bearings when teamed with tool, stainless steel and chromium carbide rings show promise of withstanding high operating temperatures imposed on airframe bearings used in aircraft and space vehicles.

* * *

A flux-free method of soldering aluminum to stainless steel at low temperatures provides a gas-tight, durable bond.

United States consumption of new rubber amounted to 130,600 long tons in September, 1961, compared with 135,198 tons in August, 1961, and 124,439 tons in September, 1960.

* * *

Cash dividend payments by corporations issuing public reports amounted to $2 billion in September, bringing the total for the first nine months of 1961 to $10 billion. September disbursements were 2 per cent higher than in the same 1960 month.

* * *

Use of a modified silicide coating and a zinc coating as oxidation-resistant agents for columbium is described in a review of new developments in the field of refractory metals. Also available is a report on developments in the technology of nickel-base and cobalt-base alloys.

* * *

Imports of steel mill products into the U. S. in August rose for the seventh consecutive month, while exports dropped. Imports of steel mill products, at 307,000 net tons, were 7000 tons higher than July's and 124,000 tons more than in August a year ago.

* * *

Using radioactive tracer methods, Soviet researchers have compiled "a large body of experimental material" on various problems of physical metallography and the theory of metallurgical processes.

* * *

A sharp post-vacation recovery brought August consumption of refined copper by mills and foundries to 143,000 short tons, 18 per cent above the corresponding month in 1960.

* * *

Heat-resistant alloys appear to be more practical for hypersonic glide vehicles under atmosphere reentry conditions than for ballistic nose cones.

Elwood P. Engel

New Chrysler Stylist

Virgin M. Exner, a Chrysler Corp. vice president and director of styling since 1953, has resigned to become a consultant.

He has been replaced by Elwood P. Engel, 45, who was Ford Motor Co.'s chief stylist for advanced and international styling. He has been made a Chrysler vice president.

Mr. Engel will report directly to Lynn A. Townsend, Chrysler president, instead of to Paul C. Ackerman, vice president and director of engineering as Mr. Exner did.

Mr. Exner has been credited with Chrysler's "forward look" styling, beginning with 1955 models and with popularizing the tail fins.

Both Mr. Engel and Mr. Exner have received awards for interior and exterior designs of Chrysler and Ford models. The Industrial Designers Institute honored Mr. Engel for the 1958 Lincoln and the 1961 Lincoln Continental.

More Chevrolet Diesels

Expansion of Chevrolet's truck line to include five heavy-duty models powered by a 195-hp, six-cylinder two-cycle GM Diesel engine has been announced by J. E. Conlan, assistant general sales manager for trucks.

Addition of the new models brings to 20 the number of Diesels offered by Chevrolet in the 15,000 to 25,000 lb. gvw. range. Earlier this year, the company introduced 15 medium-duty models powered by a four-cylinder, 130 hp. two-cycle 4-53 GM Diesel.

The heavy-duty six-cylinder Diesel will be offered in three low-cab-forward and two tilt-cab models, with gvw. ranging from 18,500 to 25,000 lbs. Max gcw. is 51,000 lbs. for all five models. Wheelbases in the low-cab-forward series are 121, 133, and 145 in. and cab-axle dimensions 60, 72, and 84 in. Tilt-cabs are available on 97 and 109 in. wheelbases with cab-axle measurements of 71 and 83 in.

The GM 6V-53 six-cylinder, 318.4 cu. in. Diesel engine is of modern, lightweight design with extremely low weight-to-horsepower ratio. Its efficient V design gives it compact overall dimensions for an uncluttered engine compartment and weight only slightly more than the gasoline engine it replaces.

An important feature of the engine is the unit injector in each cylinder to meter, pressurize, and inject the fuel directly into the combustion chamber. Because all high pressure is developed within the injector tip, fuel supply lines are not subject to rupture, leakage and air lock from high pressures as in conventional systems.

A five-speed Spicer close ratio transmission and 18,500 lb. Eaton two-speed rear axle with highway ratios provide optimum performance for heavy pulling and adequate highway speed.

Full air brakes are standard on all heavy-duty Diesels, as are a 205 ampere-hour battery and 52 ampere alternating current generator. Available as optional equipment on 133 and 145 in. wheelbase low-cab-forward models are I-beam front suspensions of 9000 and 11,000 lb capacity.

Safety Group's Head

Victor Holt, Jr., executive vice president of the Goodyear Tire & Rubber Co., has been elected chairman of the board of directors of the Auto Industries Highway Safety Committee.

SAE's 1962 Congress

The Society of Automotive Engineers will hold its 1962 Automotive Engineering Congress and Exposition in Detroit Jan. 8 through 12. The Exposition will feature more than 300 displays by suppliers of the aircraft and automotive industries in 200,000 sq ft of display space in Cobo Hall.

Over 80 technical sessions with 200 papers are planned for the Congress meeting. Among the sessions planned are those covering what is being done to solve the commuter transportation problem in large metropolitan areas, powerplants for tomorrow's vehicles, the latest achievements in the auto industry's war on engine exhaust fumes, and the potential for magnetic forming.

RECONNAISSANCE VEHICLE CONTRACT

Cadillac Div. of General Motors Corp. has been awarded $14.9 million contract for the M-114 reconnaissance vehicle which will be produced in Cleveland. The tracked M-114 is capable of 40 mph over rough terrain.

How Ford Launched Its 221-Cu In. V-8 Engine Program at Cleveland Plant

Problems incident to the launching of a new engine program and the response of management makes for interesting reading in these days of large numbers and extremely high costs. The specific program described here is the introduction of the new 221-cu in. V-8 engine in the Ford family.

Here is the first opportunity to explore in advance the problems of reliability and quality control for a new program of major importance.

Initial planning took place more than a year ago when this engine was officially approved for production. The first question to be resolved was where the engine would be built. For various economic reasons management decided to house the program in its Cleveland Engine Plant One which was then producing the 292-cu in. V-8.

Entire Program Shifted

By June, 1960, this plant began to clear the way for large volume production of the 221-cu in. engine. In the first phase, the entire program for continuing manufacture of the 292-cu in. engine was shifted to Cleveland Engine Plant Two. This plant had been producing the 292-cu in. engine together with other engines.

This phase was critical since it was decided that the equipment then employed for the manufacture of the 292-cu in. engine was to be rebuilt and retooled for producing the new engine. Consequently, the plant management had to decide immediately how much equipment would be required for the new engine.

Management next turned to the machine tool builders who had supplied the equipment originally for rebuilding and retooling the machines to suit the new engine. Although all of them were cooperative and submitted bids, the management eventually placed the rebuilding program with a smaller group, on the basis of price and delivery.

The plant was shut down in September, 1960, for the major changeover. However, prior to that and as far back as June, 1960, certain smaller items of equipment that could be spared were being shipped out for rebuilding. By September, all the equipment was on the road to wherever the rebuilding plants were located.

Late in July, 1961, a great deal of the rebuilt equipment, at least for one full line, was already on hand. As a matter of fact, the initial group of engineering and test engines had been produced in June, 1961, on the new line. Since then the remaining items of equipment have been coming in on schedule.

It was decided at the outset that the plant would build a total of 600 complete engines strictly for test purposes—hot test at the plant, engineering laboratory dynamometer testing, road cars, proving ground cars, etc. These engines were all painted green for identification. And it was agreed that ultimately all of the engines and parts produced for this advance program would be scrapped after they had served their purpose.

704 Test Engines

Actually, by the end of July, 1961, the plant had produced 704 engines for tests of all kinds.

As each engine completed its particular test schedule—and these schedules covered the gamut of conditions—it was returned to Plant One for tear-down and inspection. At tear-down the engines were taken apart and each one was carefully inspected, checked, and measured and the results noted on a quality analysis form. This report, incidentally, was routed around the organization to everyone who had an interest.

By the end of July, 1961, the plant was engaged in the final phases of this program. To insure complete coordination of product engineering and manufacturing, representatives of the various product design groups have been required to check each individual piece, including nuts and bolts, to make sure that the accepted parts from the new line met all engineering requirements as to dimensional tolerances, surface finish, etc.

One More Step Ahead

As a matter of fact, management added one more step in this process. When the product engineer signifies that he is satisfied with his particular part, he is required to initial a form for that part. This constitutes the OK for production release. Obviously, it is at this time that both product engineering and manufacturing reach agreement on any modifications that may seem necessary to produce the part most economically.

This entire procedure marks a fresh step in the advance planning for new products. It ties engineering and manufacturing even more intimately than ever before. Yet it still embodies the major phases of a new program—equipment and tooling; and product design. The new phase, described above, includes the reliability concept which, in essence, demands that quality must be built into the product from the start. It can't be inspected into the product.

While all of this procedure entails a great deal of expense, it will certainly pay off in manufacturing economies as well as in a reduction in warranty costs.

Ramblers in Argentina

American Motors has been granted approval by the Argentine government for manufacture there of Rambler models. Under terms of the agreement, Industrias Kaiser Argentina will start assembly of the cars in January.

American Motors is investing $3.5 million in I.K.A. and its subsidiaries as part of the manufacturing agreement. Production fixtures and machines, shipped from American Motors' Kenosha, Wis., facilities, presently are being installed at the plant in Cordoba, Argentina.

Cast Connecting Rods

The unique Buick V-6 engine, described in AUTOMOTIVE INDUSTRIES, October 1, 1961, has some additional features worth noting. First is the use of cast ArmaSteel connecting rods, marking the first time that cast rods have replaced forged rods in a production motor car engine. A long period of testing preceded their introduction. Buick engineers report the cast rods have adequate physical properties and none broke during tests.

Cast connecting rods are processed over the same machine line as are forged rods. Some adjustment has been made in cutting speeds and feeds, marking an increase over forged rod practice, approximating speeds for cast iron.

The crankshaft for the V-6 too is sand-cast of ArmaSteel. Among the practical advantages of the cast crank is that no machining is required on the counterweights: no OD turning and no cheeking. Both ArmaSteel parts are supplied by the Central Foundry Div. of General Motors.

A recent tour of the Buick engine plant reveals that the V-6 cylinder block is machined on a transfer line used originally for machining V-8 blocks. The entire line was rebuilt and equipped with the new heads to accommodate the hole patterns. Incidentally, the hole pattern for the front and rear faces is exactly the same as for the 215-cu in. aluminum V-8 to provide for interchangeability of components.

In setting up the rebuilt transfer machine line, Buick added two Sundstrand milling machines, one of these being installed at the start of the line just ahead of the Cincinnati surface broaching machine. The mill is employed for various locator operations required for fixturing the block in subsequent operations.

Wilson Automation links have been added at a number of points to join sections of the transfer machine into a completely automatic cycle. Centri-Spray automation has been added at the end of the line for the automatic transfer of blocks from the honing operation to the new Sheffield six-spindle gaging machine for sizing and grading cylinder bores.

Helicopter Contracts

The Army has awarded contracts to three aircraft companies for test quantities of a new light observation helicopter designed to improve Army reconnaissance and mobility.

The firms and the value of their contracts are: Bell Helicopter Co., $5.7 million; Hiller Aircraft Corp., $6.5 million, and Hughes Tool Co., Aircraft Div., $6.3 million.

Contracts call for delivery of five aircraft by each company on a one-per-month basis starting in October, 1963.

Designs submitted by the three companies were selected by the Army from those submitted by 12 concerns. All three designs were adjudged as capable of meeting rigid Army specifications for a lightweight, single rotor, four-place helicopter.

It will be powered by a 250 hp gas turbine engine and will have a top speed of 110 knots.

FLEX WING VEHICLE TESTED

Wings of cloth or other flexible material are used on Ryan Aeronautical Co. prototype. Plastic-coated nylon material is attached to a keel and leading edge members to form a V-shaped kite-like surface which supports the platform suspended beneath the wing. Wide range of applications include powered and unpowered, manned and unmanned vehicles.

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Cold-Finishing of Alloy Steels: The Cold-Drawing of Bars

Cold-finishing of alloy bars may be divided into two general categories: (1) cold-drawing, where the bars are pulled through a die with no surface removal; and (2) turning and grinding, and grinding and polishing both of which remove the surface. Only the cold-drawing procedure is discussed here.

Cold-drawing is the process of pulling a pickled-and-limed bar through a die for the purpose of producing a bright, smooth surface finish, and close tolerances. The alloy bars are prepared for cold-drawing by pickling in a hot solution of dilute sulphuric acid for removal of scale. This is followed by a water rinse, and immersion in a hot lime-water bath to neutralize the effects of the acid, as well as to aid in carrying special liquid lubricants into the die.

Alloy bars may be cold-drawn in any of four conditions: *as-rolled*, *normalized*, *annealed* (lamellar or spheroidized), or *quenched and tempered*. These conditions are determined by the grade of alloy steel, the hardness, and the mechanical properties desired for a given end use.

In cold-drawing, the alloy bar is machine-pointed to reduce the size at one end so it will pass easily into the die opening. Otherwise, the bar is pushed or extruded into the die by an auxiliary device. A die-holder, which can be made to contain from one to four dies, is mounted in an appropriate head assembled across a "draw bench," so that from one to four bars can be drawn at the same time. The draw bench has a bed which accommodates a 4-wheel buggy with jaws that grip the pointed ends of the bars as they emerge from the dies. The buggy has a hook on one end which engages an endless chain, thereby pulling the bars entirely through the dies.

After cold-drawing, each bar feeds automatically into a straightening machine, and is sheared or "cracker-cut" to length on appropriate machines. Saws are used when the cross-sections of the bars are too large to be cracked or sheared, or when square ends are required.

Smaller sizes in the form of coils are drawn on "bull-blocks," or "wire-blocks," depending on sizes, followed by straightening and cutting on special machines.

Specifications for chemical composition, grain size, hardenability, and the like, of cold-drawn alloy steels have been given long study by Bethlehem metallurgists. If you would like suggestions on cold-drawn products, or any other problem concerning alloy steels, our metallurgists will be glad to give you all possible help, without cost or obligation on your part.

In addition to manufacturing the entire range of AISI alloy steels, Bethlehem produces special analysis steels and the full range of hot-rolled carbon grades.

This series of alloy steel advertisements is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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Circle 118 on Inquiry Card for more data

MEN IN THE NEWS

P. R. Mallory & Co., Inc. — Richard J. Lee has been named director of plant services.

Ford Motor Co., Lincoln-Mercury Div. — Blaine Cooke has been appointed market research manager.

General Motors Corp., Chevrolet Motor Div.—Alex C. Mair has been promoted to assistant chief engineer in charge of truck body and chassis design.

Gleason Works — Harry J. Hart has been appointed export manager.

C. M. Hall Lamp Co., Flexible Cable Div.—Alfred Botti has been named manager.

Joseph T. Ryerson & Son, Inc.—Robert H. Wasz (far left) has been appointed assistant vice president and Norman F. Rewoldt has been named manager of the San Francisco plant.

Chrysler Corp.—**John H. Berry** has been promoted to manager of the Plymouth-Detroit assembly plant.

Ford Motor Co., Finance Staff—**Wilson W. Sick** has been named manager, product profit analysis dept. and **Clifford M. Fellows** has been appointed manager, forward plans dept.

Seneca Falls Machine Co.—**Russell M. Wheeler** has been promoted to manager of production and quality control and **Arthur S. Dinsmore** has been named chief engineer.

Ford Motor Co., Metal Stamping Div.—**R. L. Logue** has been named assistant chief engineer-body development engineering; **A. P. Piziali** has been appointed assistant chief engineer-body design development, and **G. J. Lawson** has been named executive engineer-product design.

Eaton Mfg. Co., Marion Div.—**Doarde C. Triponi** has been appointed chief metallurgist.

Electric Autolite Co.—**Robert M. Burch** has been promoted to director of automotive original equipment.

General Motors Corp., Cadillac Motor Car Div.—**Lee H. Varblow** has been promoted to assistant works manager and **Alvin J. Lore** has been named superintendent of methods and equipment.

Marmon-Herrington Co., Inc.—**Richard O. Thomas** has been appointed executive vice president.

Leece-Neville Co.—**Robert G. Hill** has been promoted to vice president-sales.

United Aircraft Corp., Pratt & Whitney Aircraft Div.—**Richard T. Baseler** has been promoted to assistant engineering manager; **Walter Doll** has been named chief engineer for advanced power systems, and **Donald J. Jordan** has been appointed chief engineer-advanced jet powerplants.

American Motors Corp.—**James T. Moore** has been promoted to product planning manager-automotive operations.

Hughes Aircraft Co.—**William L. Hoffman** has been appointed director of administration and materiel.

Snyder Corp.—**John C. Shovlin** has been named sales engineer.

Chrysler Corp., Power Train Group—**Donald E. Brichta** has been promoted to manager-purchasing.

Mack Trucks, Inc.—**Joseph I. Andreini** has been named acting plant manager in Hagerstown, Md.

National Automatic Tool Co., Inc., Induction Heating Equipment Div.—**W. K. Ginman** has been appointed sales manager.

Fairchild Stratos Corp.—**L. E. Kirk, Jr.**, has been named assistant to the president.

E. W. Bliss Co., Hastings Div.—**N. Laurence Desmond** has been named factory manager.

Necrology

Maj. Gen. Gladeon M. Barnes, (ret) Assistant Chief of Ordnance during World War II and retired vice president of the Budd Co. in charge of research, died Nov. 15 in Washington, D. C.

Ellery J. Cloutier, Sr., 67, retired automotive engineer with Graham-Paige, Chrysler, Briggs and Ford, died Nov. 13 in Birmingham, Mich.

Tore Franzen, 74, retired staff engineer for Chrysler Corp., died Nov. 13 in Grosse Point Park, Mich.

Walter C. Suerth, 54, assistant director of purchases for McLouth Steel Corp., died Nov. 11 in Dearborn, Mich.

William A. Darrah, vice president of Lindberg Engineering Co. and holder of more than 100 patents, died in Chicago.

Leighton L. Maxim, 51, vice president of Maxim Motor Co., died Nov. 8 in Middleboro, Mass.

Glenn H. Hoppin, 81, designer of the Ford tri-motor plane, died Oct. 31 in Detroit.

IF IT MUST SLIDE ROLL STRIKE SEAL ...OR DEFY HEAVY LOADS AND ABRASION FROM −80° F. TO +250° F. ... MAKE IT WITH

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URETHANE RUBBER

PROPERTIES OF CURED ADIPRENE POLYMERS				
*Hardness, Durometer A	88	95	97	99+
Hardness, Durometer D	43	50	60	78
Modulus, 300%, psi	2100	3200	7000	—
**Tensile Strength at Break, psi	7000	8825	8500	8500
Elongation at Break, %	450	480	340	250
Izod Impact Notched ft.-lbs./in.	Flexed	Flexed	20	1.2
Split Tear, ASTM-D 470 lbs./linear inch	50	155	160	200
***Compression/Deflection, psi @ 5% defl.	575	750	1800	6000
Rebound Resilience, %	45	40	42	45
Oil Resistance	Excellent	Excellent	Excellent	Excellent
Low Temperature Brittle Point, °F.	Lower than −80	Lower than −80	Lower than −80	Lower than −80

* Softer compounds ranging from 10 Durometer A are also available. ** Samples pulled @ 1 in./minute (elastomer stocks normally pulled @ 20 in./min.) *** Shape Factor—1.0

For more information write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. AI-12, Wilmington 98, Delaware.

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an Editorial

A Salute to Ordnance

THE UNITED STATES ARMY ORDNANCE CORPS has two prime jobs. First, it provides the Army with the tools of war, i.e., tanks, guns, ammunition, trucks, missiles and the like. Second, it keeps those things in top-notch operating condition wherever they may be in the world. The size of the annual budget has been running about 3½ billion dollars. There are about 90 Ordnance Corps installations located throughout the Nation.

IN ORGANIZATION, THE ORDNANCE CORPS is set up something like the typical automobile company. Just as automotive manufacturers have divisions grouped by product classifications, the Ordnance Corps also has operating divisions which are better known as Material Commands. These include:

1. (AOMC) The Army Ordnance Missile Command at Huntsville, Ala., headed by Maj. Gen. A. Schomburg. This Command developed and launched Explorer One, the Free-World's first satellite. It is responsible for all Army missiles: Pershing, Redstone, Jupiter, Honest John, Corporal, Sergeant, LaCrosse and the Nike air defense family, including the Nike-Zeus, etc.

2. (OSWAC) The Ordnance Special Weapons-Ammunition Command at Dover, N. J., headed by Major General W. Ghormley, is responsible for ammunition of all kinds and nuclear and conventional warheads furnished to AOMC.

3. (OWC) The Ordnance Weapons Command at the Rock Island Arsenal, Rock Island, Ill., headed by Brig. Gen. E. J. Gibson, is responsible for guns of all kinds, including rifles, machine guns, artillery and tank guns.

4. (OTAC) The Ordnance-Tank Automotive Command at Detroit is headed by Brig. Gen. J. F. Thorlin, and is responsible for all of the Army's automotive vehicles. In 1962 it will have the added responsibility of all of the vehicles for the Navy, Air Force and Marine Corps. Typical vehicles for which OTAC is responsible include more than 100 varieties of tanks, trucks, self-propelled artillery, sedans, busses, armored personnel carriers, missile carriers, mechanical mules and so on. OTAC is directly responsible for providing land mobility for all of the U. S. Armed Forces. On a dollar sales basis, the $1.2 billion budget for 1962 makes OTAC the 32nd largest business in the country. About 5000 people are employed at OTAC. Some $800 million worth of government owned machine tools are controlled on allocation by OTAC. This Command provides, supports and maintains more than one million vehicles on location in 44 countries throughout the world.

DURING DECEMBER INDUSTRY TRADITIONALLY salutes the Ordnance Corps at the annual Industrial Preparedness Day program of the American Ordnance Association at New York City. This year executives throughout industry have a very special reason for rededicating themselves and their organizations to programs of increased cooperation with the Ordnance Corps and its four Commands. The constant threat of continuing small scale local conflicts throughout the world has steadily increased. America's capability of successfully opposing this world-wide trend toward local conflicts rests upon the success of the Ordnance Corps in constantly improving and developing the necessary equipment and facilities for providing maximum mobility and fire-power for use in such engagements. Industrial cooperation with the Ordnance Corps should receive the highest and first priority of operations in every plant in which services and facilities are provided to this strong arm of America's defense systems.

Hartley W Barclay

Editor and Publisher

9 A.M.—RUSH CALL. OEM CUSTOMER OUT OF BEARINGS

In 4 hours, BCA personal service had emergency supply on the way!

The frantic call came from an OEM customer. His normal bearings inventory had vanished under a rush order. Production was screaming for bearings. How fast could we deliver?

In just four hours, a two-day emergency supply of bearings was packed and on its way by air. At the same time, an additional five-day supply was being loaded for truck shipment to the customer.

Personal service like this is not unusual at BCA, though we much prefer orders placed in the normal fashion. Because we're flexible in operation, we're able to eliminate red tape and wasted time. This is good for us, and even better for our customers. And this is true not only for delivery, but for engineering and production operations, too.

In addition, BCA offers complete research and engineering facilities and equipment, including specially designed machines for testing bearings, often under conditions identical to customers' actual operating conditions.

We make ball bearings for OEM and replacement use, in a complete range of types and sizes, for almost every industry . . . automotive, machine tool, construction, agriculture, and others. For complete information or technical assistance on bearings problems, contact Bearings Company of America, Division of Federal-Mogul-Bower Bearings, Inc., Lancaster, Pa.

BCA

BEARINGS COMPANY OF AMERICA

ball bearings

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC.

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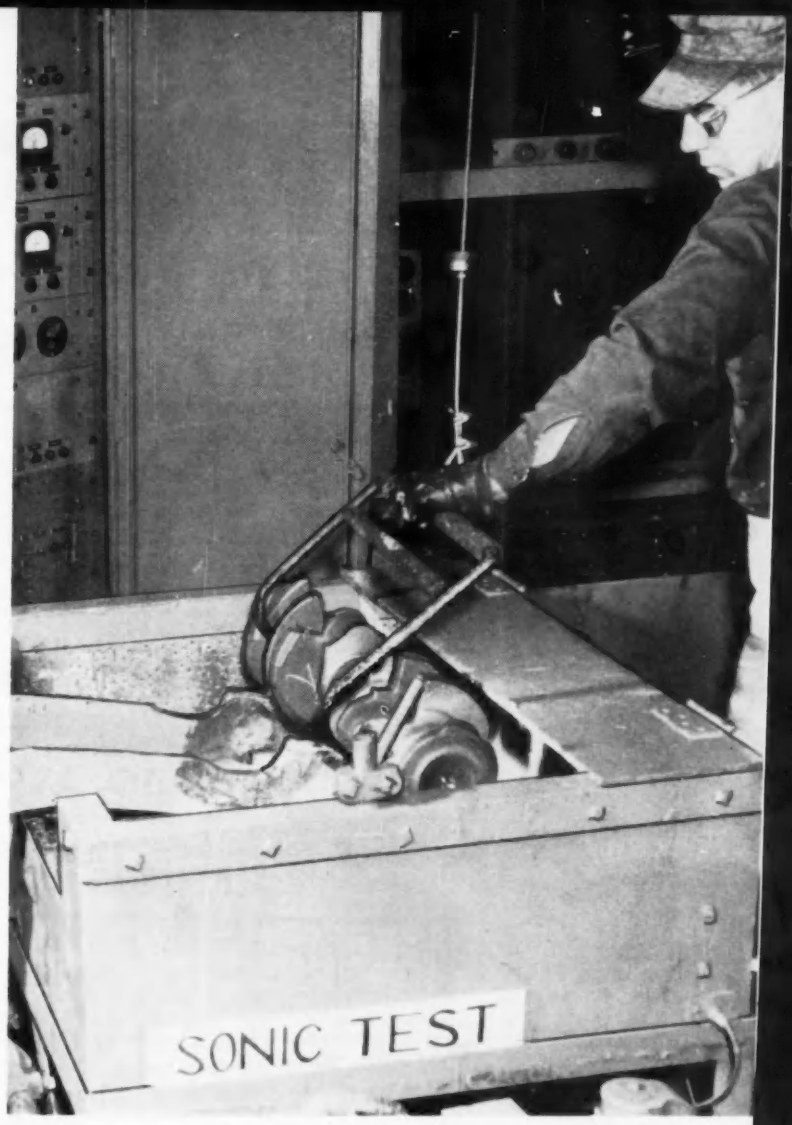


The frequency of sound waves created by striking a crankshaft with a hammer in this testing operation is checked by electronic equipment which compares results with a GM division standard

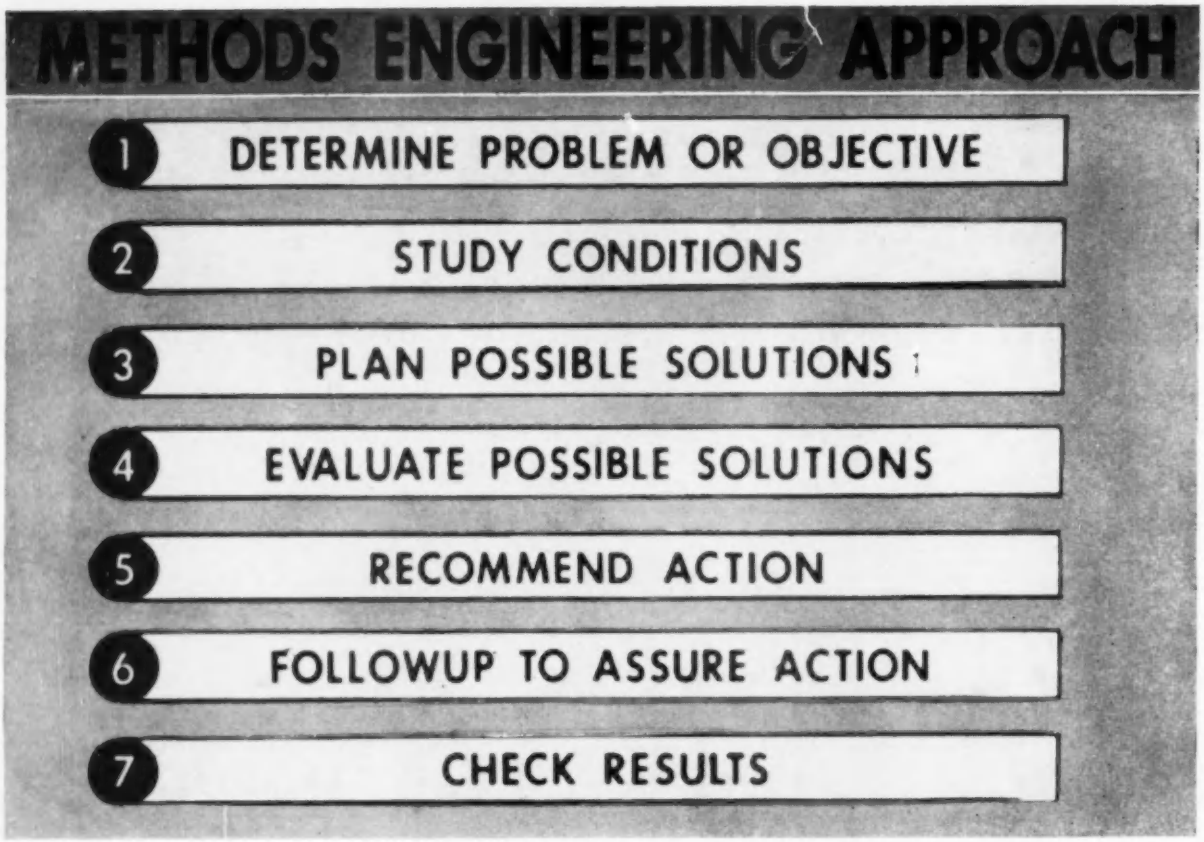
GENERAL MOTORS "Methods" at Work

By Hartley W. Barclay

THE evolution of "team methods" for production improvement operations has become a significant advance in General Motors Corporation. The technique extends throughout the company in one form or another. To illustrate and describe the methods it was desirable to choose an example which would represent virtually a cross-section of the kinds of production typical of the whole company. Such an example exists in McKinnon Industries, Ltd., at St. Catharines, Ontario.

McKinnon is the largest automotive parts manufacturer in Canada. It has two plants, employing an average of 4500 people. Although it is a subsidiary of General Motors, it also sells to other automotive companies.

McKinnon products include most of the running gear components, V-8 engines, three and four speed transmissions, rear axle assemblies, front-end components, propeller shaft assemblies, conventional and power steering gears, shock absorbers, starting motors, generators, voltage regulators, distributor assemblies, coils, fuel pumps,



spark plugs, radios, oil filters and ball and roller bearings. The McKinnon foundry and forge shop supplies castings and forgings. The facilities have been described, according to D. J. McIntosh, Supervisor, Methods Engineering at McKinnon, as a "General Motors Corporation under one roof."

In 1957 the Manufacturing Development Staff of General Motors Corporation supplied three staff methods engineers to McKinnon to demonstrate the team approach to Methods Engineering with an in-plant project at McKinnon. Management was keenly aware of the very vital need for a more aggressive program of cost reduction necessary to keep pace with the rising costs of labor, material and services facing the industry and to become even more competitive with the highest quality products at the lowest possible cost. In the past, and up to the beginning of 1958, most of all the improvement projects originated within the Master Mechanics and Works Standards areas. Cost reduction was integrated with the processing of new models and products and regular time study. The new organization for improvement included the three G. M. C. staffers, two McKinnon engineers, a process and works standards engineer, and the group reported directly to the Factory Manager.

Using a case example of devising improvement proposals for manufacturing steering gear assemblies, results were obtained in seven weeks which reflected a return of 363 per cent on the cost of the improvement. These results confirmed management's belief that substantial cost reduction is possible when skilled personnel are given the facilities for such tasks and "above all, charged with the sole responsibility of cost reduction," according to Mr. McIntosh. Examples of such improvements and a full description of the projects were described by Mr. McIntosh at the annual ence of the Society for the Advancement of Management and the American Society of Mechanical Engineers in New York last April.

Another example of dramatic results was cited. Improvements were made which reduced the production cost of an item 2 per cent. It achieved a 1500 per cent return on the cost of the facilities. For each $1.00 of cost for improved or changed facilities, according to Mr. McIntosh, $15.00 in annual saving was realized.

A novel development on the part of the team was the design and construction of a "Portable Team Office" from which cost reduction studies were made. The office was constructed of standard 4 ft x 8 ft plywood sections bolted together to form a windowless enclosure 8 ft long and 4 ft wide and 4 ft high. The inside is lined with Celotex panels on which study data can be displayed. The office is strategically located on the manufacturing floor adjacent to the area under investigation. Having no roof, additional lighting, heating or fire protection is unnecessary. It is used effectively by being moved about the plants for "on the job location" during

the "Study of Conditions" phase of a team project. It is stored when not in use.

PRODUCTION SUPERVISION AIDS TEAM

Cost reduction depends on improvement. Improvement depends on the successful installation of new ideas and better methods. These cannot be successfully installed, and generally not even developed, without the complete co-operation of all segments of the overall organization.

Co-operation within the existing organization—the willingness to go along with improvement ideas and with a new service, cannot be provided by management or purchased by the Methods Engineer.

This must be earned by the Methods Engineer, Mr. McIntosh pointed out. It is the direct result of day to day work with people and their individual personalities—the result of having proved the abilities of personnel through previous accomplishments—and the results of having assisted in solving a problem for an individual or a department.

It is vitally necessary to have the production supervisions' complete co-operation. It is they who must initially agree that improvements developed by the team for recommendation are feasible from the manufacturing viewpoint.

To generate co-operation and to overcome the natural resistance to change inherent in most individuals, the team is augmented by the line foreman and general foreman. Discussions are held to review all improvements prior to any recommendations.

The production supervision then becomes a part of the project, and all improvements developed for recommendation are partially as a result of their efforts.

The team therefore, upon the completion of the project has complete approval by the supervision of the area in which the improvements will be installed, and the co-operation so necessary for the successful installation of the improvements in the manufacturing procedure.

TYPICAL OBJECTIVES

1 **Improve Quality**

2 **Improve Materials Handling**

3 **Develop Most Economical Layout**

4 **Reduce Indirect Costs**

5 **Design Most Efficient Workplace Layouts**

6 **Analyze: Make or Buy**

7 **Reduce Scrap**

PLANNED APPROACH DESCRIBED

The planned approach used by the "team" is termed in General Motors as "The Methods Engineering Approach." It states a seven-step plan for logical analysis and action to solve a problem or to obtain an objective. These steps are briefly listed as follows:

"METHODS ENGINEERING APPROACH"

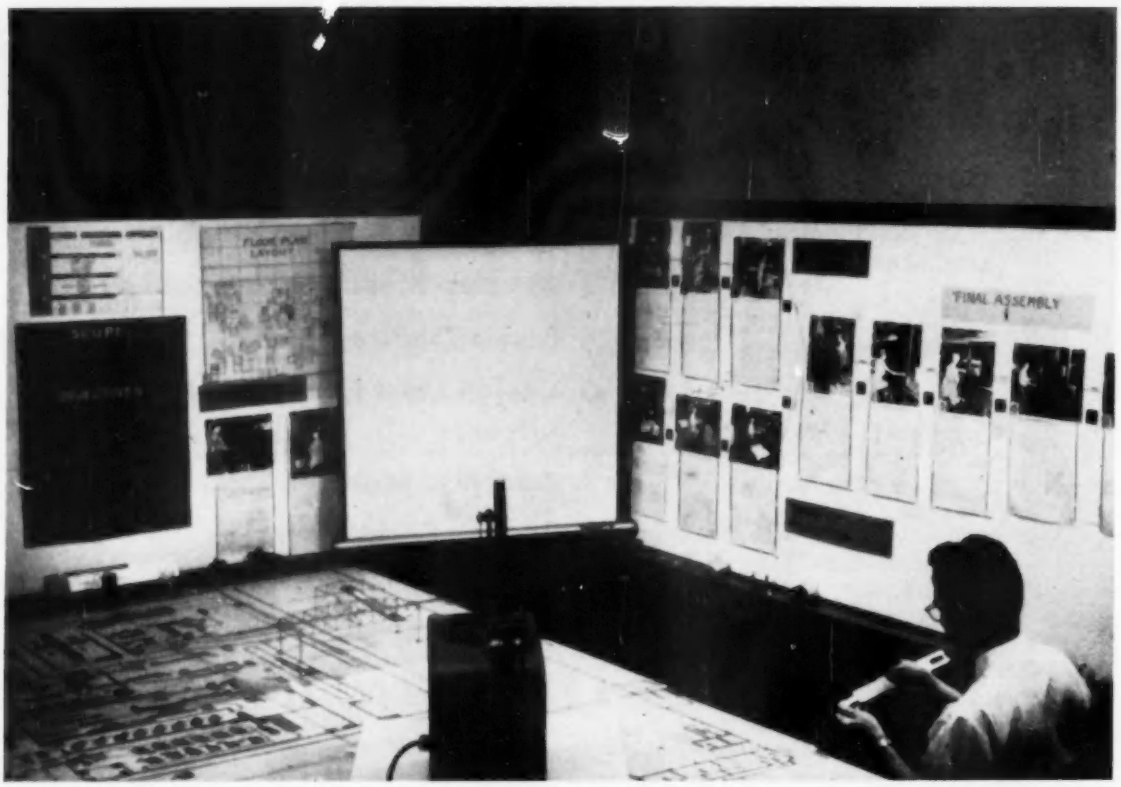
1. **Determine Problem or Objective**
2. **Study Conditions**
3. **Plan Possible Solutions**
4. **Evaluate Possible Solutions**
5. **Recommend Action**
6. **Follow-up to Insure Action**
7. **Check Results**

This seven-step approach is followed specifically by the Methods Engineering Team and forms the pattern for action during a cost reduction project. The techniques applied during each step of the approach begin with the first step which is, to "Determine the Problem or Objective." Selection of an area or a product to be studied generally results from a request by supervision or preliminary investigation by the Methods supervisor and the manufacturing superintendent. The team is assigned to the area and discussions are held with the manufacturing supervision which includes the area foreman, his general foreman and the superintendent. Objectives for the study are determined in relation to existing conditions and problems.

The foreman informs all production operators of the purpose of the team study prior to work by the team on the manufacturing floor. An initial tour of the area is made by the team with the foreman to determine the scope within which the study will be contained. It is important to define the scope to prevent the study from developing into other areas which, although they may have a direct effect on certain conditions within the study area, generally should be subjected to a later and separate investigation.

In some cases, depending on the nature of the problem, the scope is expanded to include a limited additional study in an allied area in order to solve problems and effect improvements in the basic study area. For example, parts machined from forgings often present problems, or, are machined by a process which is largely a result of the condition of the forging. In this case changes to the forgings could be necessary before the maximum improvements in machining methods can be achieved.

(Continued on next page)



The portable study headquarters is made of movable plywood sections so that improvement data, photographs, movies and reports can be studied in work centers located actually in the departments being studied by engineering analysts.

COST REDUCTION FORMULA

Top Management Support
plus
Skilled Personnel
plus
Sole Responsibility
plus
Necessary Facilities
plus
Cooperation of 1 Manufacturing 2 Service Depts.
plus
Aggressive Planned Approach
plus
Continuous Improvement for Continuous Cost Reduction

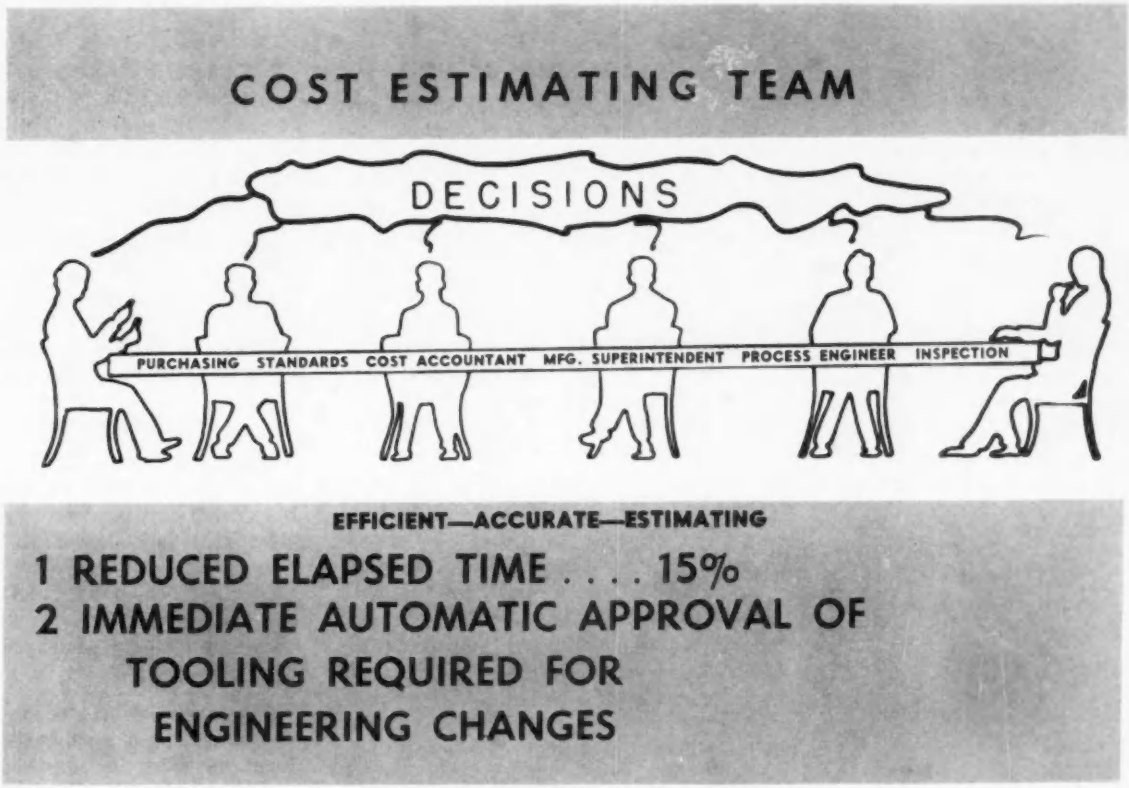
The second step is the "Study of Conditions." This step of the approach is possibly the most important, as it is the period during which each member of the team becomes intimately aware of existing conditions on the manufacturing floor, Mr. McIntosh emphasized. The study of conditions must be a complete and thorough investigation by the team of the process, equipment, methods, work place layout, operator's problems, foreman's problems, material flow, in process and in storage inventories, floor plan layout, estimated gross and net production, machine efficiency, machine maintenance costs, percentage of inspection, percent rejected and scrapped, manpower and shift production, schedule data, product specifications and quality requirements. Not until these data and complete information package are obtained, and not until each team member becomes completely familiar with all phases of the production area, is the team in a position to develop improved methods for cost reduction.

STUDY PLAN EVOLVED

To insure that the data compiled are complete, and that the team members know the operation thoroughly, a definite plan is followed.

1. Right and Left Hand Charts for each operator or operation are made.

2. During the visual analysis of each operation, a


COST ESTIMATING TEAM
DECISIONS
PURCHASING STANDARDS COST ACCOUNTANT MFG. SUPERINTENDENT PROCESS ENGINEER INSPECTION
EFFICIENT—ACCURATE—ESTIMATING
1 REDUCED ELAPSED TIME 15%
2 IMMEDIATE AUTOMATIC APPROVAL OF TOOLING REQUIRED FOR ENGINEERING CHANGES

The "team" concept is used throughout the corporation to evaluate improvement suggestions and projects. Under certain kinds of conditions such studies result in a virtually automatic approval of tooling required for engineering changes. In the team shown above representatives of specialized studies include executives from purchasing, cost accounting, manufacturing, process engineering, inspection, and standards. Each team member has a voice in making decisions.

"Method's Analysis Information Detail Form" is completed. This covers 17 major information points pertaining to production operations.

3. Still Photographs are taken of each operation.

4. Movies of each operation are taken, generally three complete cycles, for analysis later in the project room.

5. A Flow Chart showing the movement of all parts is made on the floor plan layout.

6. "Sequence Possibility Charts" are developed for each part of the product in the area.

7. Sample parts from each operation are obtained for more thorough discussion later.

The Still Photographs, Charts and Information Detail Forms for each of the operations are displayed on the walls of the project room in operation sequence. Thorough discussions of the operations are held so that each member of the team becomes completely familiar with the overall operation within the area.

Any further questions are listed and answers obtained by the team. This exhaustive study of the area prepares the team for the next step. Plan Possible Solutions.

PLANNING POSSIBLE SOLUTIONS

The techniques used in this step of the "Approach" are termed "Idea Development" more commonly known as Brainstorming. Each team member reviews individually in detail each of the operations for which he developed the data in the preceding step. On each

TYPICAL RESULTS

Team Project Area	*Manufacturing Cost Reduction*
Steering Gear	**20%**
Fan and Water Pump Bearing	**15%**
Propeller Shaft	**15%**
Rear Axle Final Assembly	**19%**
Rear Axle Shaft	**25%**

AVERAGE RATIO

Savings vs Cost *2:1*

operation after review the team develops all possible solutions or improvements. The theme at this time is positive thinking with absolutely no evaluation allowed. During these sessions everything becomes possible, nothing is impossible.

With this technique the team with the foreman and general foreman averages 30 possible improvement ideas for each operation. Depending on the nature of the operation the Team has developed as many as 70 individual ideas for improvement on a single operation.

All of the ideas or solutions are recorded on chart paper as they are developed during the session and kept within visual range of all, by posting on the project room walls for ready reference.

EVALUATING POSSIBLE SOLUTIONS

The first phase of evaluation of possible solutions is accomplished by review of the ideas developed during which the team eliminates those which are readily recognized as being impractical either for engineering or economic reasons. This quick evaluation generally reduces the number of possible improvements by 50 per cent leaving an average of 15 for each operation requiring further evaluation. At this point each improvement is recorded separately for further evaluation by the team when all the necessary data required for a decision is obtained.

Final evaluation results in more than one plan for consideration and recommendation. The first plan considered is one utilizing the existing facilities with only minor alterations. This is evaluated for cost reduction in relation to the existing method in effect. Alternate plans are considered which are developed utilizing either additional or new facilities. These are evaluated for cost reduction only in relation to the first plan which in effect is the best possible method using existing facilities. This method of evaluation insures recommendation by the team of the plan with the greatest potential and return.

RECOMMEND ACTION

The fifth step of the planned approach, "Recommend Action," is accomplished by the team through presentation to management of a Cost Estimate or Proposal. The Proposal contains the complete data necessary for management approval of the appropriation of funds for cost of facilities to accomplish the improvements. It contains a summary of the individual improvements, annual savings, revised labor routings, floor plan layout, and estimated cost of facilities.

THE FOLLOW-UP STEP

Follow-Up to Insure Action on team recommendations, the sixth step of the approach is the next responsibility of the Methods Department. When the approved project is received one team member is assigned the responsibility of completing the project by incorporating all improvements into the manufacturing procedure. This involves planning rearrangement of equipment, issuing orders for tool design and tool making, procuring machine tools and expense equipment and setting up a schedule for installation with the production division in a manner that does not interefere with production schedules. It includes working with production supervision until all improvements are in operation as planned.

CHECKING RESULTS

When all improvements are installed, and permanent rates have been established by Work Standards, complete reports are developed to indicate actual savings achieved. The report also indicates performance data of the Methods Engineering Group by relating the actual to the original estimate.

These reports serve two important purposes:

1. To enable all those who are involved in Methods Team projects to review the actual results obtained in relation to their original objective and estimate. This, it is believed, will continually increase the accuracy and effectiveness of future projects.
2. To inform all concerned of the results of the Methods Team activity and its part in the overall program of cost reduction throughout the whole organization.

Some of the cost reduction results achieved through the use of the Methods Engineering Team concept as an effective tool for cost reduction are tabulated in an accompanying box on page 40.

CONCLUSIONS

Many additional advantages result from the Methods Engineering Team activity that are not measurable in dollars. The production supervision, having worked closely with the team, become more cost conscious. They continue to improve their operations through better methods.

Employe relations are greatly improved during a team project. The team members in discussion with each operator become aware of their problems and suggest solutions. Employe suggestions are encouraged by the team and the employe is assisted in submitting his ideas through the regular Suggestion Plan. This results in an increase in suggestions and awards to the production operators during a team project and gains their cooperation. The team activity stimulates the whole organization to become more cost reduction conscious through better methods. ■

Fuel Tax Harvest

Motor fuel sales taxes and motor vehicle license fees paid to states in the fiscal year 1961 accounted for more than 26 per cent of the total $19,002 million collected, according to figures released by the U. S. Dept. of Commerce.

Motor fuel levies of $3,431 million were 18.1 per cent of the total, while automobile license fees of $1,516 million accounted for eight per cent of all collections.

The fuel tax figures represented a 2.9 per cent rise while motor vehicle license receipts rose 3.3 per cent.

By
Norman M. Lloyd
MARKETS EDITOR

Power Hand Tools IN AUTOMOTIVE ASSEMBLY

Chrysler Plant Goes to "Double Tooling" for Quality and Reliability

Holes are drilled pneumatically for outside body door moldings

THE people at Chrysler's Newark, Delaware, assembly plant are quality control addicts. Convinced that there is nothing more expensive than a customer's complaint, they have put "teeth" into a number of programs that forecast the image of defect-free inspection cards.

One of the most impressive, but least publicized, is the system for measuring the performance of power hand tools. With almost 900 tools in daily use on the assembly line, plus spares and specials, the program is geared to hit any evidence of tool deficiency long before it could show up as a recurring malady and influence production demerits.

Far and away, the biggest headache has been power torqueing problems.

Although the primary purpose of tightening a bolt is to give it, by elastic elongation, sufficient tension to secure the required load, torque must be maintained with reasonable accuracy. Excessive tension may sufficiently exceed a bolt's elastic limit to cause tensile failure. Insufficient tension may permit fatigue failure of a bolt by not giving proper support or resistance to movement of the part it is designed to secure.

Much used muscle for tightening is provided by

power torqueing tools—stall, adjustable clutch, and impact type. Some have been doing the job, but others are chronically unable to operate within the required torque range. On identical nuts and bolts, some pre-set torque wrenches have varied as much as 40 per cent between maximum and minimum torque.

Operations on the line at the Newark plant that require accurate torque settings are backed up with standard torque wrenches.

Some examples of back-up tooling are:

- **application**—tight assemble propeller shaft to transmission flange studs
  torque spec.—20-40 lb ft
  tool—torque-controlled impact wrench
  problem — unable to hold torque within limits
  solution — back-up with standard torque wrench

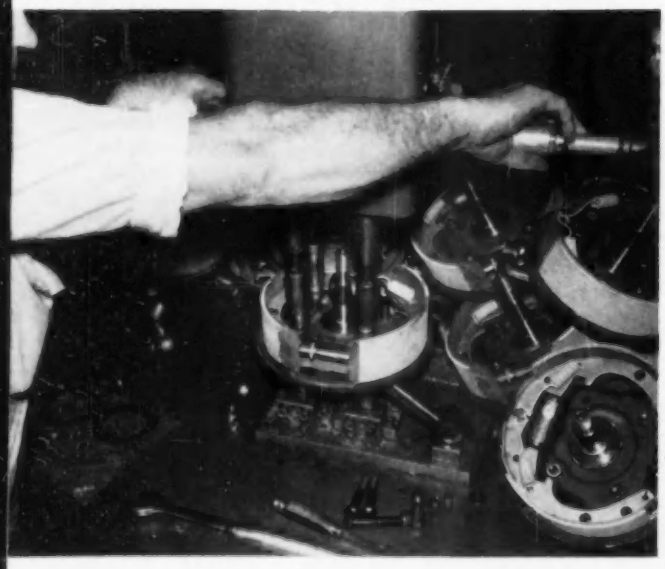
- **application** — tight assemble rear spring front bracket to body
  torque spec.—30-50 lb ft
  tool—stall torque nut setter
  problem—same as above
  solution—same as above

- **application**—tight assemble lower rear spring shackle nut
  torque spec.—20-40 lb ft (small car); 30-50 lb ft (big car)
  tool—right angle stall torque nut setter
  problem—same as above
  solution—same as above

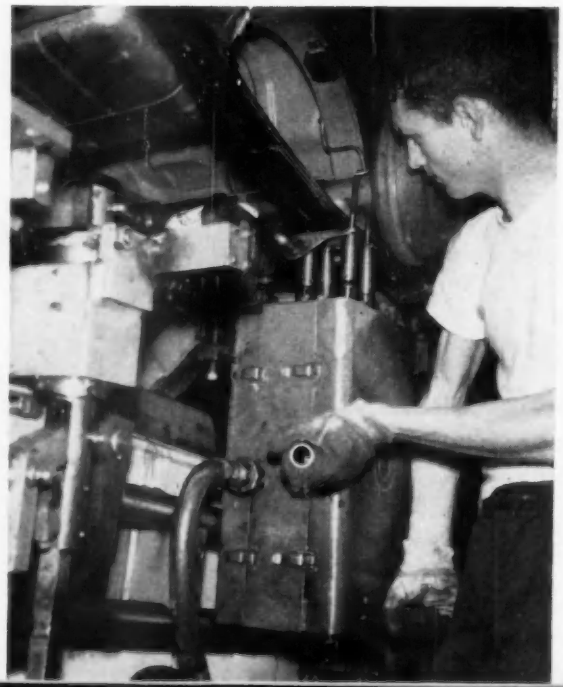
- **application**—doors to body
  torque spec.—25 lb ft, ± 5 lb ft
  problem — wrench stalls due to burrs, dirt, etc.—screws not set
  solution — impact wrench to set screw, back-up torque controlled impact wrench to set torque

Chrysler Torque Control Program

Three-spindle nut runner installs front wheel spindle to brake back plate



Four-spindle nut runner tightens "U" bolts on rear springs



- **application**—tight assemble wheel nuts to studs
  torque spec.—50-70 lb ft
  tool — torque controlled impact wrench
  problem—can't hold torque
  solution — back-up with standard torque wrench; now using multiple-spindle stall torque nut runner

- **application** — set toe-in-locking clamps
  torque spec.—150-200 lb in.
  tool—right angle stall torque nut runner
  problem—can't hold torque
  solution—hand torque wrench coupled with air tool

Although this "double tooling" has meant another man, another tool and another unit of cost, it dramatically emphasizes how sensitive Chrysler is to product performance and reliability. It also defines just one of the ways in which the company has sharpened quality control to give the buyer a product that will not "unravel."

The problem has been compounded by some suppliers who have reportedly done a bad job of service and replacement parts. As one Process Engineer put it, "They sell us a bad tool . . . they don't back it up . . . and then they send us expensive, yet poorly made and inspected replacement parts."

Pneumatic hog ring tool secures rear seat back cover to springs

Torque Control Program—Much thought, second thought, revision and consultation have gone into the program that continuously grinds away at achieving and maintaining new levels of performance.

Specialists from no less than eight departments act as a collective clearing house for all torqueing problems. Teamwork begins on the drawing board and literally never ends. The assessment of operating tools "just keeps rollin' along."

Quality Engineering, in a true sense, acts as a focal point for information on tool deficiencies. Specifically, the department:

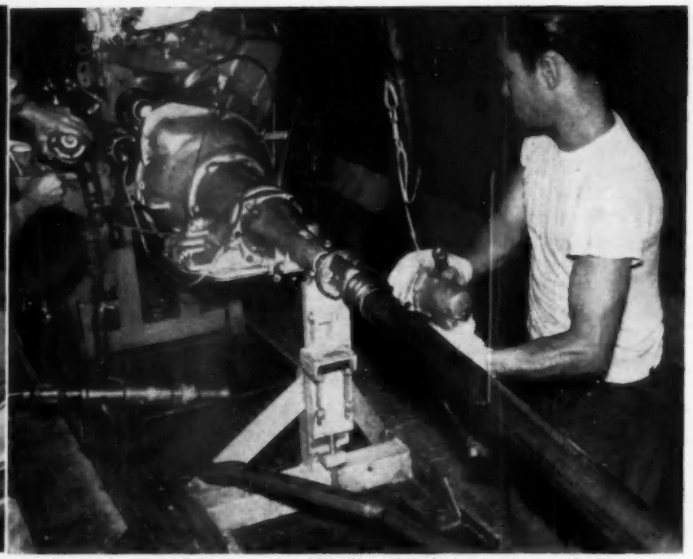
- **examines the manufacturing process**
- **isolates the cause**
- **assigns the responsibility**
- **develops reporting systems for corrective action**

Standards Engineering, referred

Lower ball joint is secured to front suspension arm with right-angle nut runner

Nut runner is used to fasten rear shock absorber

Impact wrench assembles clutch-brake support bracket



Impact wrench is used to install driveshaft to transmission

Push-button selector switch for automatic transmission is secured by a ratchet wrench with right angle attachment.

to as Car Engineering, is primarily responsible for:

- measuring torque problems related to engineering design
- liaison between design engineering and assembly
- establishing special tests and facilities for torque quality control (metallurgical laboratory, standard parts catalogue, parts substitution, and engineering design changes in torque specs.)

Manufacturing Engineering, which is perhaps most sensitive to the operator and the tool in terms of rated performance, provides the following services:

- two torque specialists check all critical torqueing operations daily and file reports that become a recorded torque history for each application
- tool engineers check all torqueing problems in their assigned areas daily
- process engineers directly influence the type of tool used, and determine torque delivery of the tool
- process engineers also work closely with Industrial Engineering relative to tool location and manpower re-arrangement

Industrial Engineering

- establish time and method standards relative to quality torqueing requirements
- make "tight" inspections of all critical torqueing operations to measure time, method and motion performance
- initiate corrective action when problems are due to production standards

Design Engineering

- initiate design that is compatible with torque process capability
- standardize hardware to facilitate tooling, production and quality control
- evaluate assembly techniques to insure success and integrity of design in terms of mass unit production

Production

- operators and tool techniques are supervised by section foreman
- foreman personally checks critical torque items on all vehicles in his area
- foreman also makes daily spot checks

Warranty and Customer Dissatisfaction

- provides Quality Engineering with information through customer research and warranty analysis; data used to establish and change Critical Torque List

Purchasing

- in conjunction with tool engineers, selects vendor sources capable of providing quality tools and replace-

ment parts in quantities compatible with production schedules

- disqualifies suppliers on the basis of product performance, technical service, replacement parts, delivery schedules, quality control, etc.
- obtains vendor corrective action with the recommendation of Quality and Tool Engineering

Case History — Torque control embraces a number of formulas geared to continuous improvement. Success of the program is evidenced by the hard fact that the extended warranty period has not caused total dollar expenditures to climb into unbalance.

Time and effort spent in nailing down the process capability of a specific tool to meet torque requirements of a job can be seen in the following case history of the wheel lug nuts.

Shooting for a tolerance of 55 lb ft ±15, some 500 torque readings of a pneumatic torque wrench were taken early in the model run under the supervision of a quality engineer. Air line pressure was constant and the same operator was used. Thread friction differences such as burrs, dirt, finish and type of assembly were closely controlled to provide an accurate relationship between torque and tension.

Readings were posted on an average and range chart, Fig. I.

With slope improperly centered, the tool engineer modified the internal clutch which allowed tool to "stall out" at a lower mean torque. Additional 500 readings provided a good compromise (Fig. II). Rather than risk lower stall point, forecast was made that tool would maintain 96 per cent of torque application within specified tolerance; 4 per cent above, and 0 per cent below.

Blank chart was posted adjacent to the operator's station. Area foreman personally made hourly checks (five readings) to measure process average. Both Quality Engineering and Tool Engineering were notified if any five readings averaged beyond the posted limits.

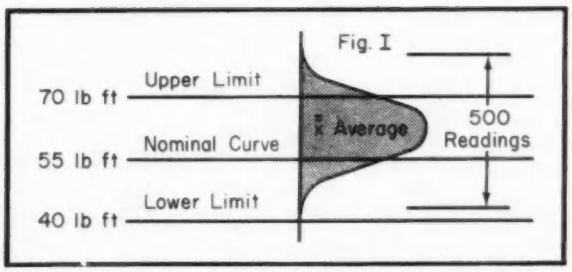
Power screwdriver is used to fasten instrument cluster to panel

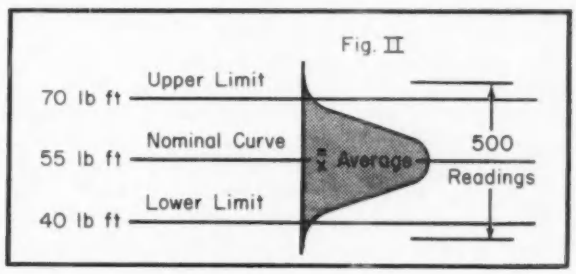
Average and range charts are posted at every torque station and are turned in daily to Quality Engineering for review and evaluation. Tool engineer also follows tool performance by studying charts twice each shift.

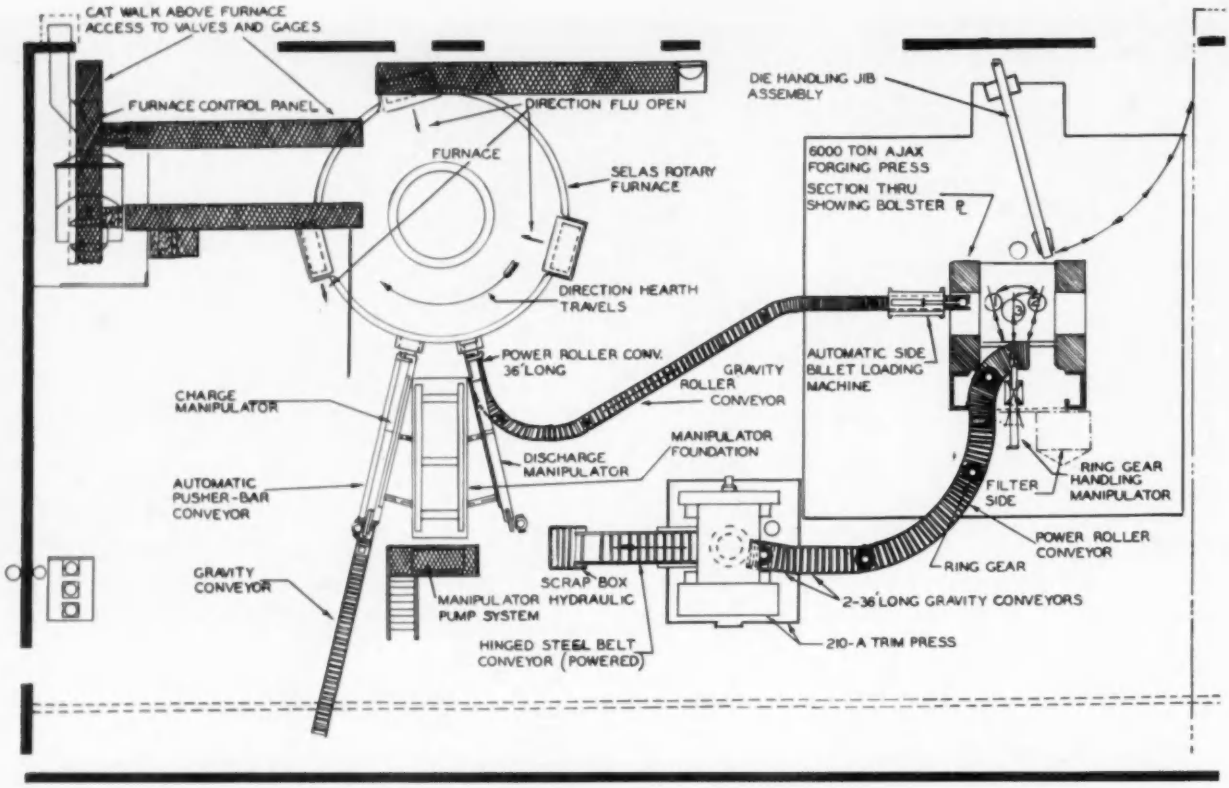
Maintenance — Tool engineers and torque check men, who must share in the responsibility for eliminating demerits from a battery of inspections and audits, continuously check the condition of lubricators, filters, hose lengths, fitting sizes, etc. Faulty accessories just don't have a chance! Even factory fresh tools are checked and lubricated before being placed into service.

Due to such factors as spongy metal conditions, compressible materials and other production variables, pre-set torque values do not necessarily reflect what the tool will translate to the operation on the line. To preclude this problem, the tool is first checked with a torque analyzer. The torque setting is then adjusted to provide the muscle required for the job . . . and then verified with a hand torque wrench. The tool is then again checked against the analyzer, and the value recorded as that which will meet the performance specification for the job.

The hand tool program is just one of the meaningful approaches to quality and reliability. Achieving and maintaining a continuous rate of improvement is a way of life at Newark, Delaware. ■







Floor plan showing arrangement of Selas furnace (left), 6000-ton Ajax mechanical forging press (right), and the various items of automation linking the entire operation.

Forging Operations at Eaton

By Joseph Geschelin

DETROIT EDITOR

EXPLORATION of new ideas in forging methods and equipment, introduction of automation devices where justified economically, and other management techniques are the key to progress at the Marion Division, Eaton Mfg. Co., Marion, Ohio. This operation, with some 170,000 sq ft of floor space, serves all of the Eaton divisions, as well as other companies; also supplies brake assemblies to a number of manufacturers of heavy duty vehicles.

What is the effect of advanced methods and new equipment on employment? It is noteworthy that employment today is 500 people compared with 300 several years ago. This is convincing evidence that improved quality, higher productivity, and lower costs have combined to attract more business with a consequent increase in employment.

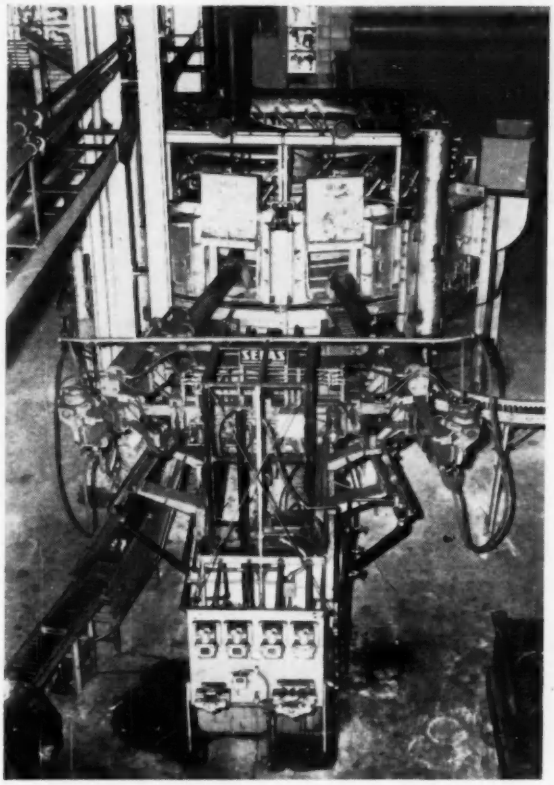
Although this is primarily a forge plant, it also includes an extensive machine shop for the machining of axle shafts and the fabrication of components for some 15,000 front and rear brake assemblies per month for heavy duty trucks.

Forging is done exclusively on mechanical presses and upsetters, the latter supplied by National, ranging from 7½-in. downward. Mechanical presses produce some 300,000 pieces per month, around 2600 tons, the pieces ranging in weight from 3 lb to 150 lb. These parts include ring gears, slack adjusters, bearing adjusters, clutch plates, helical gears, side gears, and differential spiders.

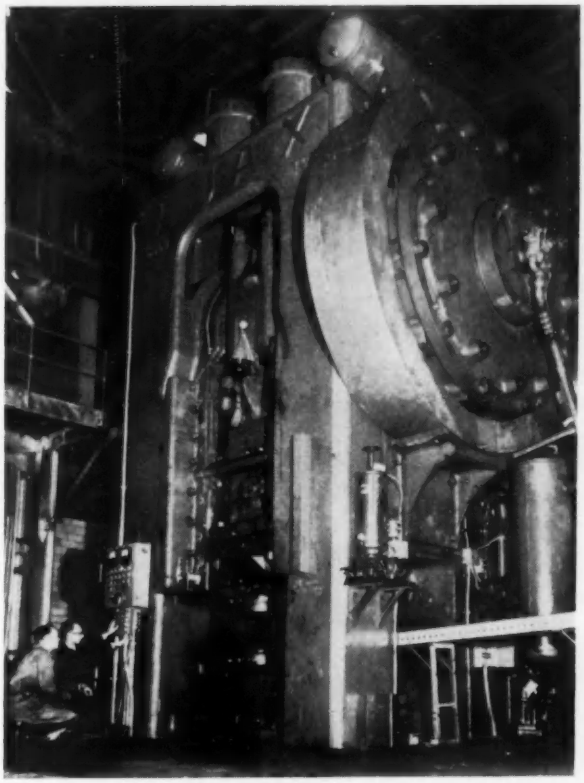
Upsetters account for some 250,000 pieces per month, ranging in weight from 5 lb to 100 lb. Such parts include flanged axle shafts, pinions, torsion bars, transmission shafts, sliding clutch gears, and brake camshafts.

Besides the basic items of equipment, noted briefly above, the plant boasts a battery of the well-known Tocco induction hardening machines for axle shafts, and Tocco forging blank heating furnaces serving some of the presses.

Axle shaft production is quite sizable, with capacity for some 40,000 pieces per month. In addition, Marion produces 15,000 brake cam-



Perspective of the Selas billet heating furnace, emphasizing the loading and unloading manipulators. At the left is the conveyor and pusher mechanism for transporting cold billets to the charging station. The unloader is at the right, dropping heated billets onto the gravity roller conveyor that leads to the Ajax press.



View of 6000-ton Ajax press. Some idea of its size may be gained by comparing with the two men at the left.

shafts per month for its brake assemblies. The company claims it is one of a few to produce induction hardened camshafts. Hardening is done on a group of two Tocco units: one hardens the spline end, the other hardens the cam end.

Biggest thing at Marion is the 6000-ton Ajax mechanical forging press, said to be one of only 10 of its kind in the world. Details of this installation were given wide publicity in the metalworking press early in 1961. To avoid repetition, this study will touch only on highlights of the Ajax press. However, the writer's recent visit to this plant made it possible to present a more complete picture of the complex, consisting of the press, the enormous Selas billet heating furnace that serves it, as well as a perspective of the unique automation devices that combine to make this a fast, automatic operation.

The layout reproduced here shows the compact arrangement of the Ajax press at the right; the Selas furnace at the left; the system of 36-ft gravity roller conveyors linking the furnace with the press; and the trim press in the foreground.

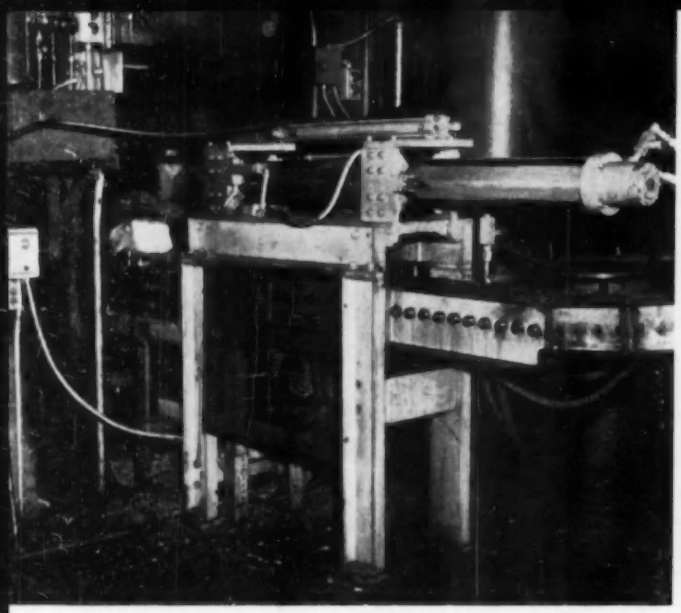
The Ajax press which can operate up to 35 strokes per minute with an 18-in. stroke, is producing at present a variety of large axle ring gears, ranging in size from 13-in. diameter and weighing 45 lb, up to 18½-in. in diameter, weighing 130 lb. Later on, dies will be supplied for producing large transmission gears and steering knuckles.

Ring gears are forged from 6-in. and 7-in. round cornered square billets in three stages as shown in the plan view of the press in the layout. The first operation takes place in the die station at "1," the second at station "2" on the opposite side, while the final finishing stage which represents the greatest amount of work is handled in the central die station "3" where the die offers maximum support. Transfer of the heated billet from station to station is handled automatically by the manipulator.

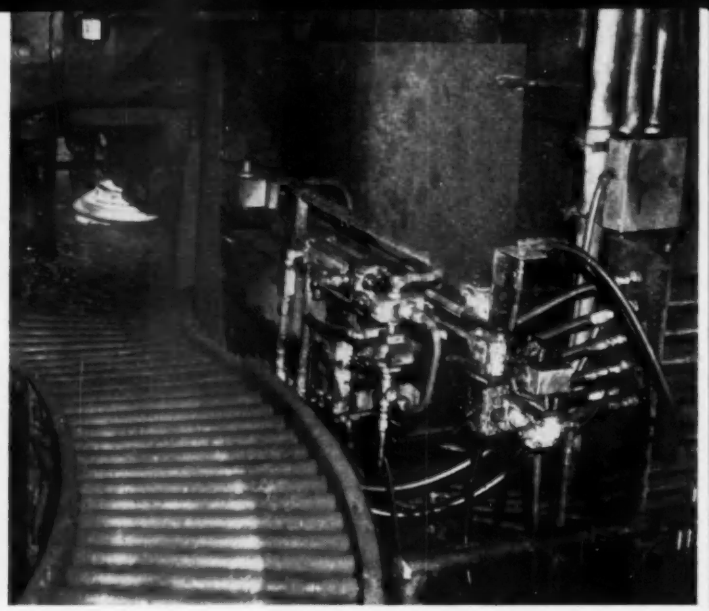
Because of the higher pressure and greater deformation available with this press method, there is a higher yield in terms of weight per piece as compared with smaller board hammers.

The Ajax press really is enormous. It has a total weight of 700 tons, die table size 70 by 74-in. The main frame casting alone is 27-ft high, 10-ft wide, and 12-ft deep, weighing 470,000 lb. It is powered by a 400-hp Louis-Allis electric motor with multiple V-belt drive.

Returning to the floor plan, it will be noted that heated blanks are withdrawn from the furnace by the manipulator and deposited on the 36-ft long gravity roller conveyor for quick transport to the press loading station on the left hand side of the press. Here the heated billet is picked up by the automatic side loading mechanism and loaded into



Close-up at corner of the Ajax press, showing the billet side-loader mechanism. Heated billets are received from the Selas furnace via the gravity roller conveyor which may be seen in the foreground.



Close-up of the forging press manipulator in action at the press bed. When the third die operation has been completed, the manipulator drops the gear blank on the gravity roller conveyor in the foreground for transport to the trim press.

the first die impression. It is noteworthy that both the side loader and press manipulator were conceived and built by the Eaton Technical Center in Cleveland.

They are operated hydraulically with a system pressure of 1000 psi, employing a 30-gpm pump driven by a 20-hp motor. Because of potential fire hazard, the hydraulic fluid is of fire-resistant type—Shell Irus No. 902. An electronic control system is employed in conjunction with the operation of these devices, Square D Norpak static control being employed for the "logic" and "output" functions of the system to assure reliability, life, and speed of the mechanisms.

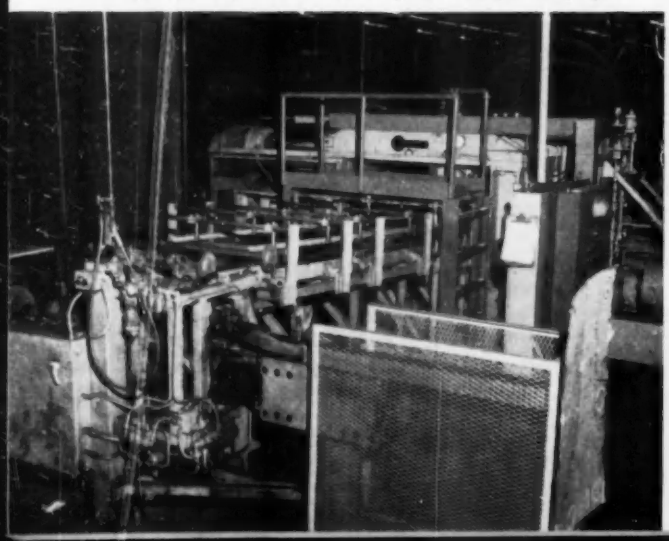
Heating of forging billets for the Ajax press is handled in the Selas rotary hearth furnace seen at the left in the drawing. It is 25-ft in diameter, capable of handling round-cornered steel billets four to seven inches square, ranging from 5½-in. to 12⅝-in. in length. The rotary hearth is automatically indexed in sequence with the handling operation through three heat-controlled zones, with capacity of 150 pieces an hour, heated to a temperature of 2400 F in 30 minutes.

The operation starts with the sawing of billets from large bars, transfer to the gravity roller conveyor at the left, progression of billets to the furnace on the automatic pusher-bar conveyor, and finally the charging of the billet into the furnace by means of the left-hand manipulator.

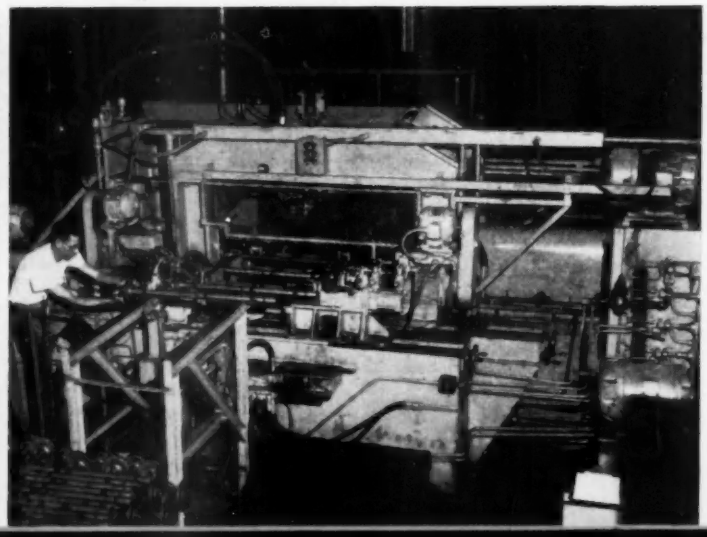
Billets are positioned on the furnace hearth in two concentric circles to achieve maximum production rates. Consequently, charging and unloading by the manipulators becomes a unique two-phase operation. In one phase, the charging peels pick up a cold billet, reach into the furnace charge door and place it on the inner row. Simultaneously, the unloader peels reach into the unloading door and grasp a hot billet from the outer row of the

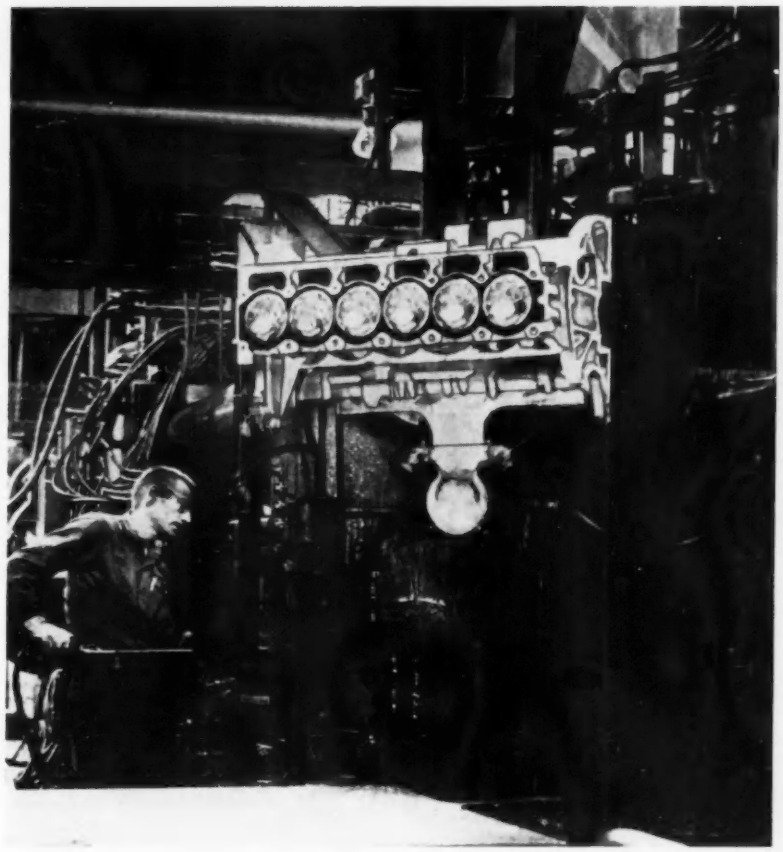
(*Turn to page* 71, *please*)

Cargill-Detroit straightening machine. Axle shafts come out of the shot blashing machine to the left and are fed in horizontal position to the straightener. The shaft end at the left is grasped by the chuck during the straightening cycle.



Exit side of the Cargill-Detroit machine. Here are the two Drillunit stations mentioned in the text. First operation is to center the shaft at both ends. The second operation is the drilling of two driving holes on the flange end.





The pick-up arm of the block unloader is seen here transporting a cylinder block from the die casting machine to the operator's station for visual inspection.

How Chrysler Makes Aluminum Cylinder Blocks

ALTHOUGH Chrysler Corporation has been producing die-cast aluminum cylinder blocks for over 18 months, little information has been available up to now on the details of the die-casting technique. This report is based on a press tour of the Chrysler Casting Plant in Kokomo incident to the announcement that optional 225-cu in. Slant Six engines for Lancer and Valiant will come through with aluminum cylinder blocks as standard.

Chrysler has been developing die-cast aluminum cylinder block techniques for several years, making progressive improvement in die design details and other aspects of the foundry process. At the present writing, cylinder blocks are produced in a separate addition to the foundry, constituting a self-contained and fully automated department. The foundry bay contains seven enormous 2000-ton Castmaster die-casting machines, two of which are fully equipped and employed for the start of 1962 production. The availability of five more of these high-cost machines surely indicates that Chrysler will stay with aluminum and, doubtless, will shift to increased volume as time goes on.

By Joseph Geschelin
DETROIT EDITOR

Since much of the interest in this project resides in the method of producing die-castings, let us look at the process in some detail. First of all consider that this giant Castmaster has a certified locking force greater than 4-million pounds, and injects molten aluminum into the die cavity at an estimated pressure of 12,000 psi. It is an enormous piece of equipment 40 ft long by 11 ft wide. Dies weigh 44,000 lb.

The die-casting cycle is fully automatic and is interlocked with a variety of automation devices. One of the major attachments to the Castmaster is an Ajax Magnethermic, duplex induction heating furnace which preheats a charge of six cylinder liners to around 900 F in a 90-sec cycle.

Cylinder liners are delivered to the induction furnace automatically and in a precisely timed cycle in groups of six. Automation for the furnace consists of a six-mandrel fixture with 180-deg movement. It accepts six cold liners on one side, turns 90-deg, delivers and holds them in vertical induction coils. When the cycle is completed, the fixture withdraws, turns 90-deg in the opposite direction, unloads the hot liners, and returns to its original position to receive cold liners. The six liners which had been ejected on the opposite side of the furnace are picked up on a telescopic loading arm and are transported rapidly to the die cavity. At this point a cylinder is actuated to transfer the liners onto the mandrels of the die. The loading arm then returns to its position at the furnace.

The entire casting cycle takes about two minutes. Another automation device is employed for unloading the casting from the die and transporting it to subsequent steps. This is a tall boom with a radial arm, tied intimately with the

The trim press used for trimming flash from cylinder blocks. Blocks are transported to this station on the power-and-free conveyor in the far background.

machine cycle. While the block is being formed in the die, the unloader hovers directly over the die. As the die finally opens, the arm lowers, reaches in to remove the block, then turns to present the block to the machine operator for visual inspection.

It is necessary to digress at this point for a mention of the extensive power-and-free conveyor complex installed by Jervis B. Webb. This system picks up liners, in batches of six, at the initial inspection station and transports them to the die-casting machines on demand. It also picks up cylinder blocks at the die-casting machine, transports them on a cooling cycle of some 54 minutes (which serves the purpose of aging in air) and parks them on an overhead storage conveyor for delivery, on demand, for a series of operations.

The hub of this conveyor system is centered about an elevator at each of the die-casting machines. The carriers containing cylinder liners wait in turn at the elevator. First phase of the cycle is the entry of an inspected block into the elevator. The block is moved upward to engage a carrier in its travel along the cooling and aging cycle. This triggers the power conveyor to release a basket of liners onto the elevator. And at this point the liners are transferred to the mandrels on the induction furnace fixture. As the liners clear, the elevator is ready to receive the next block, etc.

Chrysler is using a modified melt of A-380 secondary aluminum alloy, containing approximately 11 per cent silicon and a small percentage of copper. Melting of the charge is handled in Lindberg melting furnaces rated around 6000 lb per hour. The melting room also has a number of Loftus furnaces, having a capacity of some 9000 lb per hour. Metal is delivered to the die casting machines on rail-mounted ladles. Here the charge is poured into a holding furnace, delivered under pressure to the die cavity at a temperature of about 1250 F.

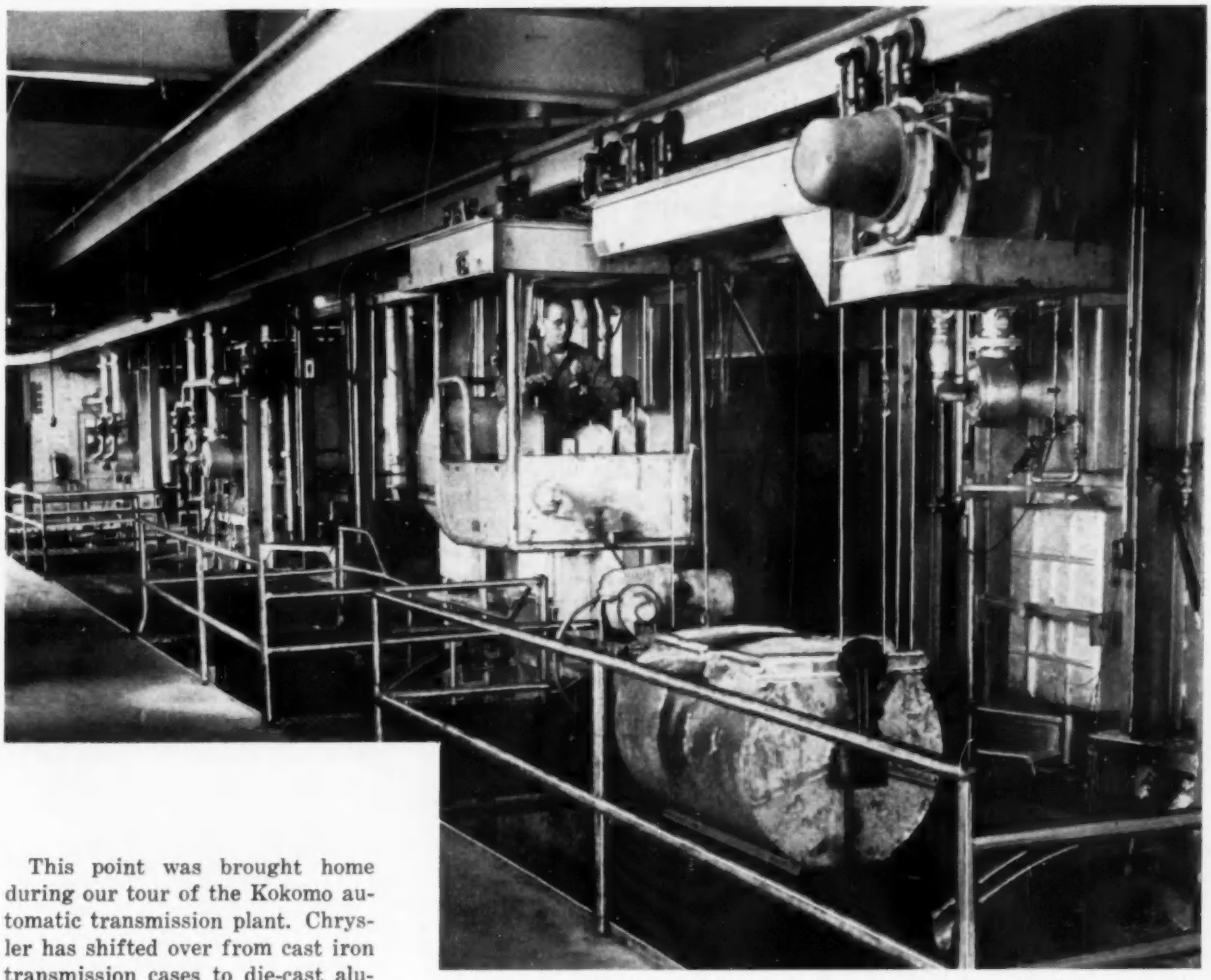
Let us now turn to other features of block production. At the very start, the cylinder liners, as received from Perfect Circle, are gaged automatically to measure ID and length. Accepted liners then are loaded in batches of six into the carriers of the power-and-free conveyor system for transport to the die casting machines.

We mentioned earlier that the power-and-free complex eventually delivered the blocks to an overhead storage area. Here they await the signal to move one by one to the first trim press. At this point the blocks are removed from the carriers and are moved manually on power-free conveyors through a number of operations. Among these are: thorough deburring in a special Wheelabrator; Magnaglo inspection of cylinder liners to assure freedom from cracks; air testing of the block in a special Wilson Automation machine to detect evidence of porosity that might lead to leakage.

It may be noted at this point that cylinder liners too are given an initial Magnaglo inspection to assure freedom from surface imperfection before they are routed to the die casting machines.

Chrysler has found that an aluminum cylinder block has many important advantages over a cast iron block. In the first place, the die-casting technique, with its highly automated cycle, produces castings at a much faster rate. Next is the matter of excellent precision, holding tolerances and wall thicknesses to limits that have not been approached up to now with sand casting. Trimming flash is a simple and rapid process, producing castings that require less metal removal and fewer operational steps on the machine line. Coordination of product design and casting techniques has made it possible to core the entire oil gallery.

The combination of less metal removal, fewer operations, and the faster cutting speeds and feeds results in greater capacity with less machine tool equipment. This, in turn, results in a corresponding decrease in floor space requirements.

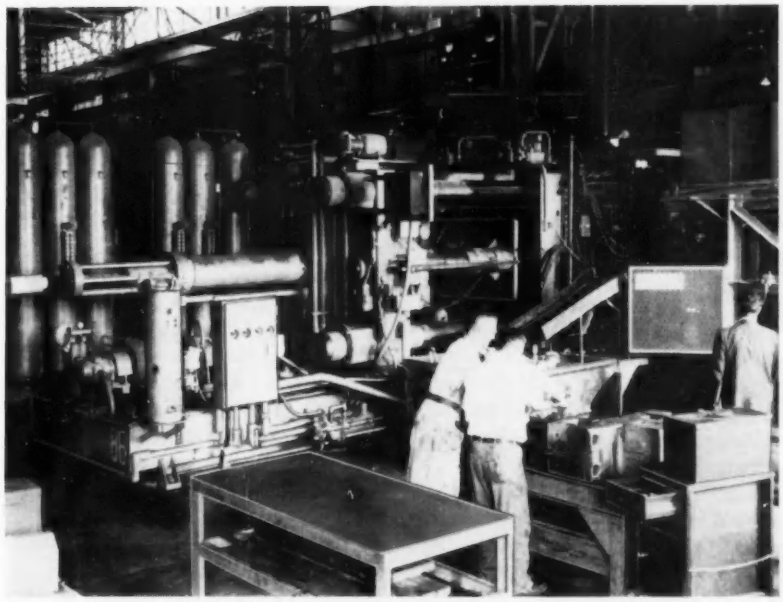


Molten alloy is picked up at the Lindberg melting furnaces for delivery to the two Castmaster machines.

This point was brought home during our tour of the Kokomo automatic transmission plant. Chrysler has shifted over from cast iron transmission cases to die-cast aluminum cases. The original transfer machine line for cast iron cases had a length of some 1200 ft. The new Barnesdril transfer machine line for aluminum cases runs only 200 ft. It has less operations to perform and, besides operating at higher speeds and feeds, it is required to remove only about 0.030-in. of metal on the average.

Another interesting feature of the Chrysler aluminum engine is the use of malleable iron main bearing caps in conjunction with cast iron liners for the upper half of the main bearing line.

The Kokomo aluminum foundry is a sizeable operation, specializing in die casting exclusively. In addition to blocks, it produces some 53 different parts for engines, transmissions, and other components, including steering gear, starter, and distributor housings. In 1961 the foundry shipped some 34-million lb of parts. Transmissions alone consume some 83,000 lb of aluminum daily. ■



Some impression of the size of the 2000-ton Castmaster machine can be gained from this view.

SAE National Aeronautic and Space Engineering and Manufacturing MEETING

By Raymond Kay
PACIFIC COAST EDITOR

MANAGERS, engineers, and production men heard some of the answers to production problems in the aerospace industry at the five-day Society of Automotive Engineers National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles.

The attendance this year was disappointing as the American Rocket Society was holding its annual meeting in New York on the same days. Many who would have attended SAE's meeting went to New York to take in ARS.

Those who came to SAE were well rewarded. The Society came up with an outstanding program. It covered almost the entire spectrum of production and engineering, missile and spacecraft design, and air transport design and operation.

Here are highlights of the Manufacturing Forum. They're of special interest to AUTOMOTIVE INDUSTRIES readers:

Unconventional Metal Removal

There's a significant improvement in drilling and tapping small holes.

Norair Div. of Northrop is at work on a development in precise control of torque and speed of machine tool equipment. This concept applied to a complex small hole job raised the drilling rate from 2 holes per minute to 90. And the number of holes made by each drill jumped from 48 to 1000.

In a slotting operation it was possible to saw a 0.003-in. slot through 0.040-in. sheet attached to a wing member for a length of 20 ft. Here torque and speed control was applied to the saw blade and the movement of the wing member as it was cut by the blade. The maximum measured tolerance on the width of the slot was 0.0004 in.

It was easy to modify existing drill presses to provide the torque and speed control. This was done by adding an analog computer controller system and installing a d-c electric motor of lower horsepower rating. The torque level is usually lower than in manual drilling operations.

The analog computer controller senses the torque and maintains it at a constant level by controlling the speed of the motor and the feed of the drill. This control of milling and turning operations is in use at several southern California aerospace plants.

Advances are reported in chemical milling and electrochemical machining. Companies say that they're chemical milling superalloys such as 15-7 PH and Rene 41 in thicknesses down to 0.007 in. with $\pm^{0.001}_{0.000}$ tolerance for complex parts to 13 ft square. They're getting surface finishes to 30-40 microinch rms.

Refractory metals such as molybdenum, tungsten, tantalum, and beryllium now are chemically milled with good results. Proper solutions of bath chemicals reduced evolution of hydrogen to negligible levels.

Electro-chemical machining techniques have improved to where they are competitive or cheaper than conventional machining. That is, where the parts are complex contoured or in a heat-treated condition.

On some complex shapes electrochemical machining can remove up to eight times as much metal as can conventional machining. When tolerances are close, though, ECM is slower.

Tolerances to 0.001 in. can be held on simple holes; to 0.010 in. on complex holes with varying radii and fillets.

With the "throwing power" of the electrical field, ECM can remove metal at differential rates—up to a ratio of ten to one. Chemical milling removes the material at a fairly uniform rate on all surfaces except those masked off.

One must carefully review use of chemically milled or ECM parts in high stress applications. Conventionally machined parts usually have surface stresses included. ECM parts do not.

T. E. Hudson, senior research engineer, The Marquardt Corp., was secretary of this important panel.

Electron Beam Welding

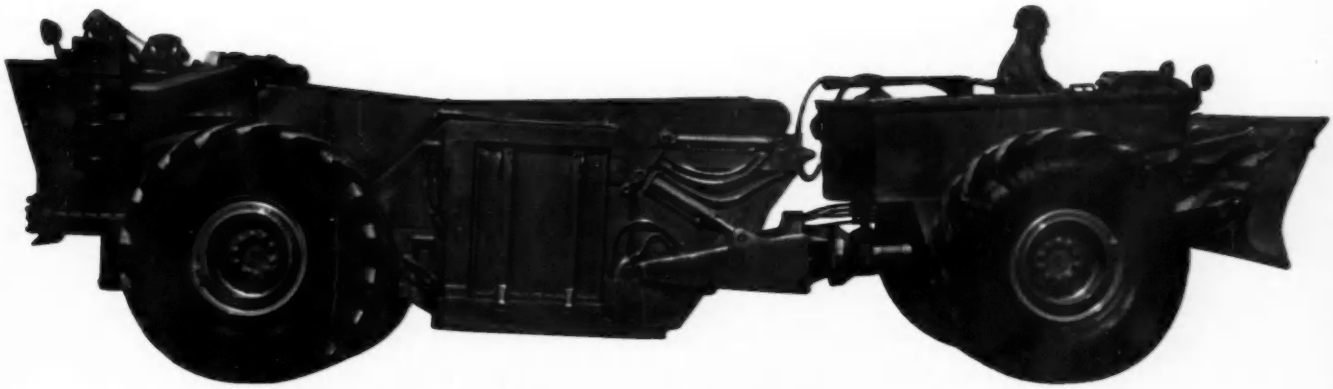
The electron beam process is a relatively new and unique fabrication method. North American Aviation believes it has great potential, according to Gerald V. Anderson, research engineer, Metallic Materials Laboratory. The company bought two 150,000-volt electron beam welding machines.

What's behind the need for this equipment? Somewhere between Mach 2.5 and 3 lies the thermal barrier to use of conventional designs and materials for aircraft structures. At Mach 2.5 aluminum structures, mechanically fastened, are adequate.

But at Mach 3 we need higher temperature alloys. From a weight standpoint, mechanical fasteners

This mark tells you a product is made of modern, dependable Steel.

it digs
it flies
it swims



Army Universal Engineer Tractor built by Hendrickson Manufacturing Company, Lyons, Illinois. Strength with light weight obtained with use of USS "T-1" Constructional Alloy Steel and USS MAN-TEN High Strength Steel.

and does a dozen other things!

The Universal Engineer Tractor, rubber tired (UET-RT), can do the work of a dozen different machines merely by substituting interchangeable sections. Basically, it is a 250 HP steel tractor-scraper dozer that can be flown in a C-130 Aircraft and parachuted into a combat area, ready to operate. In addition, being sectionalized, it can be quickly disassembled for transport by other types of aircraft.

Although it is lightweight for airborne use, the tractor can transport 10 cubic yards of earth at 35 MPH. It was designed by Barnes & Reinecke, Inc., Chicago engineers, to the requirements of the United States Army Engineer Research and Development Laboratories at Fort Belvoir, Virginia. Three and a half tons of weight were saved by designing the yoke, dozer arms, front and rear axle housings, and basic bowl structure with USS "T-1" Constructional Alloy Steel. "T-1" Steel's minimum yield strength of 100,000 psi permitted working stresses of 60,000 psi.

USS MAN-TEN High Strength Steel with 50,000 psi minimum yield point, in the bowl, side plates and dozer blade saved more weight. The complete unit was built tough and strong with 7,500 pounds of USS "T-1" and MAN-TEN Steels.

For other military vehicles, United States Steel makes extremely tough, rolled armor plate, in addition to a complete line of weldable, formable, high strength and alloy steels. For more information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. USS, "T-1" and MAN-TEN are registered trademarks.

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USS United States Steel

airborne crane built 500 pounds lighter with USS TRI-TEN High-Strength Low-Alloy Steel

Lightweight crane built strong with USS TRI-TEN High-Strength Low-Alloy Steel. Designed for the U.S. Army Corps of Engineers, Ft. Belvoir, Virginia. Builder: Koehring Co., Milwaukee, Wisconsin.

This air transportable, air droppable U.S. Army crane had to be strong enough to lift 7 tons but light enough to be parachuted into a combat area. The Koehring Company of Milwaukee, Wisconsin, solved the problem with USS TRI-TEN High-Strength Low-Alloy Steel.

By using USS TRI-TEN Steel in the turntable, the lower works of the cruiser, and the boom, Koehring designers used only two tons of steel . . . with a clear saving of 500 pounds. Strength was not sacrificed because USS TRI-TEN Steel has a minimum yield point of 50,000 psi.

USS TRI-TEN Steel is well known as one of the most weldable and toughest high-strength low-alloy steels in the industry. Its superior notch toughness at low temperature makes it ideal for all-weather mobile equipment. TRI-TEN Steel has excellent weldability, good resistance to abrasion, and high atmospheric-corrosion resistance.

For other military vehicles, United States Steel makes extremely tough, rolled alloy armor plate, in addition to a complete line of high strength steels, "T-1" Constructional Alloy Steel, Stainless Steels and carbon steels. For more information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. USS, "T-1" and TRI-TEN are registered trademarks

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This mark tells you a product is made of modern, dependable Steel.

USS United States Steel

for joining are impractical. So we need new and unique fabrication methods, such as electron beam welding.

Electron beam welders are versatile. At North American, the 150,000-volt machine butt welds material as thin as ¼-mil titanium foil and as thick as ½-in. plate.

J. W. Meier, development engineer, Hamilton Standard Div. of United Aircraft Corp., also spoke at this forum. Compared with other joining techniques, he finds that high power-density electron beam welding has these four major advantages:

(1) Jobs are done with a low total energy input. This minimizes both distortion and effects on material properties of the workpiece.

(2) The process can be controlled relative to the energy input, spot size, and spot position.

(3) The process is extremely pure in a chemical sense. It permits joining without contamination of the workpiece.

(4) It's possible now to join many dissimilar and non-metallic materials. This was a tough task before.

Mr. Meier feels the electron beam process will fill many current technical needs. But, even more important, it will make possible future new and unique design concepts, both in product configuration and in materials used.

The high power density of the electron beam has, as its "natural" atmosphere, a hard vacuum. This makes it useful in certain welding applications. One problem which vacuum welding promises to solve is joining reactive metals—tungsten, beryllium, and molybdenum. These are embrittled by a few parts per million of atmospheric contaminants.

Rocketdyne Div. of North American Aviation studied the problem. E. G. Thompson, senior research engineer, reported these findings: The electron beam process is superior to the tungsten, inert-arc process for welding molybdenum-base materials. It wasn't necessary to preheat in order to eliminate weld cracking. There was no distortion in welded panels. And welds had improved ductility.

But for structural uses, weld profiles weren't good enough. And stresses in welds made with high voltage equipment were so great that the slightest mishandling resulted in cracking.

Economic Factors in The Selection of Material

What about materials for space vehicles? W. R. Lucas, of the George C. Marshall Space Flight Center, National Aeronautics & Space Agency, says we probably won't be able to count on finding brand new materials. We'll have to make more efficient use of those we now have.

"This can come through better understanding of their basic nature and of the environment in which they must perform.

"Of course, we'd be delighted to have new materials that would solve many of our problems. But we're not standing by waiting for breakthroughs. We're seeking to apply what's available," Mr. Lucas says.

Five major factors influence the economics of materials selection for solid propellant rocket motors. They are vehicle mission, construction materials, fabrication methods, quantity and production rate, and quality control needs. So says Polaris Program Associate Manager W. O. Wetmore, of Aerojet-General Corp., Sacramento, Calif.

Problems When Handling Radioactive and/or Toxic Materials

If your company is handling toxic and radioactive materials, here are a few tips from the Los Angeles Health Dept. on how to promote health and safety measures:

(1) Review all plans for new construction, installation, and processing with persons expert in industrial hygiene and health physics. Be sure to recognize and control all possible health hazards.

(2) Make sure that controls are provided, maintained, and used.

(3) Be aware of new hazards. Be sure there is competent health review of questionable new materials, methods, and devices.

Ground Support Equipment

As missile weapon systems get more important in our defense picture, so does GSE (ground support equipment). Today, this covers a vast product range. Typical: missile carrying trailers, complex launchers, control towers, vacuum cleaners, jacks, small welders, transtainers.

Keith G. Powers, senior systems engineer, Consolidated Systems Corp., reported on this subject. He noted design, application, and cost of GSE for manned aircraft are vastly different than for a missile weapon system.

Support equipment for manned aircraft is largely stationary. And one installation can keep many planes in the air. But each launch site for a missile weapon system needs a complete maintenance and checkout setup.

Total cost of a defense system is weapons plus vehicles and supporting equipment. Ground support for missiles takes more than twice as much of the total budget as that for manned ircraft.

The changing role and needs of GSE is bringing changes in relative cost. In a manned aircraft system, the aircraft represented some 80 per cent of cost. Now the missile itself represents only 15-20 per cent.

Cost of support equipment climbed from 20 per cent for aircraft to 45 per cent for the missile weapon system. The rest of the expense in the missile weapon system is in facilities sometimes called ground operating equipment. And even this falls within the Air Force's definition of GSE. Equipment, bases, installation, devices, and associated services are all a must to launch a missile.

Mr. Powers reported that the Pentagon is developing mobile GSE units. A single one can serve a number of launch sites. And so cut costs. Also, it can support the growing array of mobile missiles.

Mobility increases the demands on GSE. For it must perform faultlessly under a variety of tough environmental conditions. ■

INDUSTRY STATISTICS

By Marcus Ainsworth, STATISTICAL EDITOR

1961 NEW PASSENGER CAR REGISTRATIONS BY MAKE AND MODEL

Make	September 1961	September 1960	Nine Months 1961	Nine Months 1960
Rambler				
American	11,166	8,508	98,021	83,789
Classic-6	16,412	20,674	152,051	215,505
Classic-8	493	977	6,828	11,952
Ambassador	1,129	1,257	13,467	16,175
TOTAL AMERICAN MTRS.	29,200	31,416	270,367	327,421
% of Total	7.88	6.85	6.40	6.63
Chrysler				
Newport	3,132	.....	35,480	.....
Windsor	656	3,540	11,107	39,314
New Yorker	917	994	14,255	15,203
Station Wagon	197	119	3,680	2,927
Total	4,902	4,653	64,502	57,444
Imperial	543	894	7,432	11,357
Dodge				
Lancer	4,359	.....	46,821	.....
Dart	10,777	19,381	110,519	246,295
Polara	620	2,382	9,882	32,325
Total	15,756	21,763	167,222	278,620
Plymouth				
Valiant	9,760	16,125	88,837	150,094
Savoy	3,492	5,555	40,596	58,985
Belvedere	3,249	3,412	33,523	46,816
Fury	2,771	2,476	34,575	41,199
Station Wagon	2,504	2,871	27,098	45,712
Total	21,776	30,439	224,629	342,806
TOTAL CHRYSLER CORP.	42,977	57,749	463,785	690,227
% of Total	11.60	12.59	10.98	13.97
Ford				
Falcon	35,702	31,004	367,502	333,587
Fairlane	19,632	31,281	210,469	323,049
Galaxie	19,758	16,712	242,173	196,367
Station Wagon	7,912	9,854	97,608	125,656
Thunderbird	4,858	6,685	60,259	61,433
Total	87,862	95,536	978,011	1,040,092
Lincoln Continental	1,832	1,266	20,752	15,839
Mercury				
Meteor	3,030	.....	34,664	.....
Monterey	3,414	8,080	38,763	76,853
Montclair	29	1,419	988	20,407
Station Wagon	886	1,419	12,424	16,232
Total	7,356	10,918	86,839	113,492
Comet	12,998	15,761	138,529	102,930
TOTAL FORD MOTOR CO.	110,048	123,481	1,224,131	1,272,353
% of Total	29.70	26.91	29.00	25.74

Make	September 1961	September 1960	Nine Months 1961	Nine Months 1960
Buick				
Special	4,443	.....	62,640	.....
Le Sabre	6,297	9,655	78,479	108,759
Invicta	1,442	2,292	20,535	29,755
Electra	1,725	2,844	32,943	40,235
Station Wagon	211	566	5,540	9,117
Total	14,118	15,357	200,137	187,866
Cadillac	8,803	9,469	100,642	107,851
Chevrolet				
Corvair	15,174	17,702	236,169	165,365
Biscayne	13,729	24,247	151,762	226,861
Bel Air	20,307	28,578	246,626	300,345
Impala	25,492	34,023	358,271	418,924
Station Wagon	7,645	14,342	130,682	175,270
Corvette	362	592	8,484	8,273
Total	82,709	119,484	1,131,994	1,295,038
Oldsmobile				
F-85	4,289	.....	50,604	.....
88	13,701	20,047	134,806	199,325
98	2,717	2,731	27,504	38,804
Station Wagon	651	1,129	10,347	15,605
Total	21,358	23,907	223,261	253,734
Pontiac				
Tempest	7,476	.....	78,164	.....
Catalina	6,754	13,277	72,917	138,382
Ventura	1,380	3,897	19,769	41,303
Star Chief	2,002	2,931	22,822	31,725
Bonneville	4,592	4,940	48,713	59,155
Station Wagon	1,406	2,519	16,666	28,514
Total	23,612	27,564	259,051	299,079
TOTAL GENERAL MOTORS	150,600	195,781	1,915,085	2,143,568
% of Total	40.65	42.67	45.37	43.37
Studebaker	4,018	8,126	49,449	84,402
% of Total	1.08	1.77	1.17	1.71
Checker	308	488	3,917	5,039
King Midget	14	17	119	196
Miscellaneous Domestic	31	1,266*	1,599	21,395*
Total	353	1,771	5,635	26,630
% of Total	.10	.39	.13	.54
Foreign	33,309	40,441	293,574	397,268
% of Total	8.99	8.82	6.95	8.04
GRAND TOTAL	370,505	458,765	4,222,026	4,941,869

* Includes De Soto.

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1961 NEW TRUCK REGISTRATIONS

Make	September 1961	August 1961	September 1960	Nine Months 1961	Nine Months 1960
Chevrolet	23,872	25,175	22,228	223,706	242,326
Ford	23,119	27,034	25,498	216,286	220,322
International	10,814	11,508	9,207	83,989	86,270
G. M. C.	5,686	6,156	6,960	50,587	63,349
Dodge	3,600	3,660	3,260	30,406	32,722
Volkswagen	2,260	2,680	2,748	20,195	24,429
Willys Truck	1,449	1,257	1,631	12,624	14,063
White	896	1,152	978	9,911	11,541
Willys Jeep	1,116	1,354	1,033	8,590	7,732
Mack	820	777	827	6,623	8,708
Studebaker	340	332	584	3,985	4,200
Divco	256	(1)	232	1,953	2,438
Diamond T	122	163	154	1,373	2,041
Kenworth	107	(1)	93	852	1,207
Brockway	106	98	68	749	840
Peterbilt	36	(1)	55	530	697
F. W. D.	30	(1)	27	409	409
All Others	196	653	489	2,298	5,319
Total	74,625	81,999	76,072	675,066	728,613

1—Included in All Others.

1961 NEW FOREIGN CAR REGISTRATIONS

Make	September 1961	September 1960	Nine Months 1961	Nine Months 1960
Volkswagen	14,887	13,900	134,411	115,467
Renault	4,696	4,165	33,712	54,061
Volvo	1,514	1,375	9,012	(1)
Triumph	1,246	1,552	8,951	14,523
Mercedes Benz	1,172	1,291	9,414	10,857
Austin Healey	849	1,309	7,234	13,743
M. G.	848	(1)	7,072	10,949
Fiat	845	1,520	9,480	17,538
Metropolitan	807	(1)	7,080	(1)
Simca	705	2,010	(1)	13,860
All Others	5,740	13,319	67,208	146,270
Total	33,309	40,441	293,574	397,268

1—Included in All Others.

News of the MACHINERY INDUSTRIES

Speakers at 60th Annual Meeting of the National Machine Tool Builders' Association Discussed a Variety of Subjects, Including Modernization, Taxes, and Foreign Markets

By Charles A. Weinert

U. S. Modernization and Developments Abroad Top Subjects at NMTBA Annual Meeting

Modernization of U. S. industry to meet world-wide competition and developments in foreign markets were discussed by speakers at the 60th Annual Meeting of the National Machine Tool Builders' Association.

All of the facts brought out point-up the importance of American industry and Government taking aggressive action to hold world markets and maintain economic strength.

Countries abroad, notably West Germany and Japan, have progressed tremendously—and to top it off, evidently are continuing prospects for advanced American-built machine tools. Two speakers from the machine tool industry reported first-hand their findings during visits to these countries this year as members of trade missions sponsored by the U. S. Dept. of Commerce.

In addition to the world situation, a new concept for "measuring" the variables in machining with the objective of improving product reliability, was outlined by one of the speakers.

Another interesting presentation was an informal discussion on various topics of current interest—by a panel made up of five machine tool executives.

This gathering also marked the election of new Association officers and directors for the forthcoming year.

FRANCIS J. TRECKER
President-Elect of NMTBA

Held on November 15-17 at Bal Harbour, the meeting had an attendance of more than 300 members and guests.

President's Report

Everett M. Hicks, 1960-61 president of NMTBA, and vice-president and general manager of Norton Company's Machine Tool Division, in his final report as Association president, commented on "some of the things" which he considers to be "important to the future of our industry."

He stressed—with rate-of-growth figures; "tempered," though, by per-capita figures — that industrial growth in other parts of the world has been gaining rapidly, while that of the United States has remained "relatively stagnant." "This lack of growth in the United States," he said, "is the cause of great concern to American industry and . . . our Administration has called attention repeatedly to the great need for modernization."

Mr. Hicks mentioned the increasing difficulty of selling machine tools abroad because of higher wage costs and prices—and stated that "if we fail to halt inflation . . . a future devaluation of our currency appears inevitable" as an undesired

WALLACE E. CARROLL
First Vice-President

WALTER K. BAILEY
Second Vice-President

LAWRENCE C. GLEASON
Treasurer

RALPH R. BALDENHOFER
Secretary

FRANCIS L. DABNEY
Director

means for making our costs competitive.

He also mentioned, with respect to American industry, that "obviously, one way to offset high wage costs is to strive for increased mechanization and automation"—but that the European companies are building automatic factories and "we have a great deal of modernization to do just to remain even with them."

Mr. Hicks suggested that besides considering "the very high cost levels in the United States in contrast with other countries in the world," a study of "our system of taxation" also should be made.

He complimented the Administration "for recognizing the vital importance of encouraging modernization and replacement" by recommending, earlier this year, a tax credit plan. And reported that not only does the Treasury Department now intend to continue pressing "for a direct tax incentive for modernization," but also will "re-form our antiquated depreciation regulations" by a revision of Bulletin F.

On the credit, he indicated that the suggestion for a "tax credit" has been seized upon by other interests for a variety of applications beyond the purpose for which the plan was originally intended.

Mr. Hicks said he thought it would be well to "review other possible methods to see whether any could be used to accomplish the desired result and . . . not be susceptible to possible abuses."

As one possibility, he described the "investment allowance" used in England, where the purchaser of a machine tool can deduct 30 per cent of the cost of the machine as extra depreciation when making his tax return for the year of acquisition. This has the net effect of reducing taxes, but is not a direct tax credit as such—being an additional depreciation allowance "made for the specific purpose of encouraging people to buy new equipment."

He said the Association was still studying the problem and "we will continue to offer our thoughts and suggestions . . . with the hope we can assist in developing legislation which will help restore a dynamic economy in the United States."

Foreign Markets

Reports that West Germany and Japan offer opportunities for U. S. machine tool exporters were presented by NMTBA members who visited these countries recently on trade missions.

William E. Rutz, industrial consultant to Giddings & Lewis Machine Tool Co., who visited West Germany, said:

"As I see it, in the years ahead, German businessmen and their companies will be eagerly seeking new methods and new equipment which will help them reduce costs. The German market is ripe for development by an energetic sales program. For a great many American business firms . . . this market holds out both a challenge and an opportunity."

Charles B. DeVlieg, chairman of the board, DeVlieg Machine Co., who visited Japan, reported a like situation in that area:

"Japan is experiencing its greatest industrial boom in its history, with production of goods and services three times greater than it was before the second world war. Its rate of increase in gross national product was 18 per cent in fiscal 1959-60, and 11 per cent in fiscal 1960-61—the highest in the world.

"I believe there is a real opportunity for American firms to sell to Japan. Our machine tool builders have a real opening. The Japanese do not need our standard type of machine tool. They have these in abundance. What they need from us is the advanced type of machine."

Mr. DeVlieg further commented that the Japanese "regard the machine tool industry as one of very great importance to their national progress," and that "one of the reasons for the great machine tool boom was a Government policy that allowed 50 per cent depreciation the first year, with the remainder spread out over 14 years."

Product Reliability

In a presentation entitled, "Testing Machine Capability and Reliability," Dorian Shainin, vice-president of the Boston management consulting firm of Rath & Strong, Inc., described a new analytical method for evaluating machine tool operations to achieve improved product reliability.

Named "Variation Research," the approach was "recently perfected with the aid of one of the country's largest automotive manufacturers." As Mr. Shainin explained in more detail:

"The inherent variability of a machine tool's product has been defined by quality control people as its capability, or natural tolerance. With planned test runs, it is now possible to separate how much variability comes from each: the machine tool itself, the material being machined, and the operator of the machine. Also of great analytical importance are three more numbers: the variability coming from factors which change with passage of time, from the cyclical activity of machining successive items, and from factors that cause a lack of uniformity within the item being machined."

Mr. Shainin predicted, "machine tool builders will soon become adept at quickly finding the narrow area within which almost all the machined product's variability is controlled" — and said that "such knowledge brings about improvements that are surprisingly substantial."

New Officers

During the meeting, the following were elected to office for the Association year 1961-62: President—Francis J. Trecker, president of Kearney & Trecker Corp.; First Vice-President—Wallace E. Carroll, chairman of American Gage & Machine Co.; Second Vice-President—Walter K. Bailey, president of the Warner & Swasey Co.; re-elected Treasurer, Lawrence C. Gleason, president and general manager of The Gleason Works; Secretary—Ralph R. Baldenhofer, vice president and general manager of The Thompson Grinder Co.

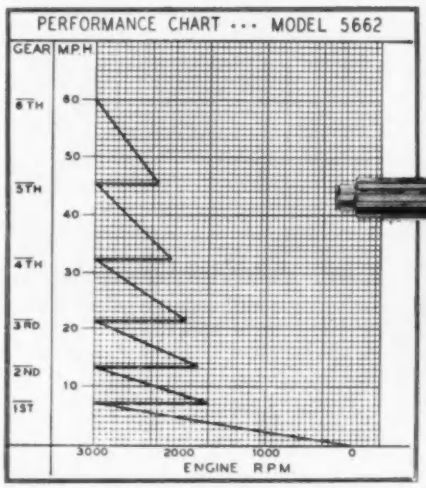
New Directors elected for three year terms were: Mr. Bailey; Mr. Baldenhofer; and Francis L. Dabney, executive vice-president of the Bullard Co.

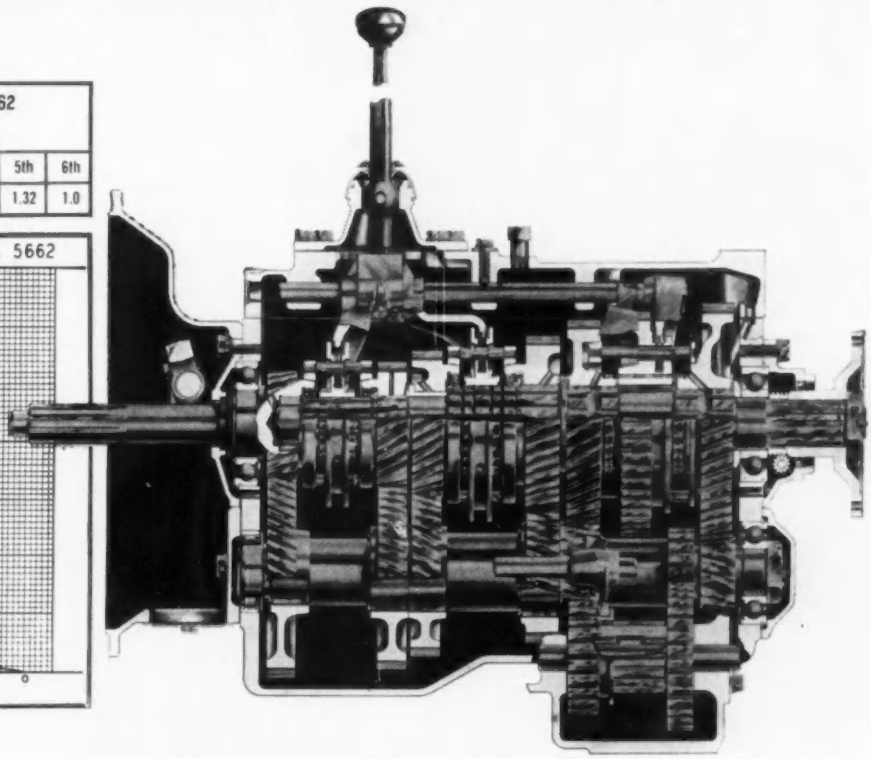
Ludlow King was re-elected Executive Vice-President. ■

NEW SPICER 6-SPEED TRANSMISSION Offers Smoother, Faster Shifts For Over-The-Road Trucks!

GEAR RATIOS OF SPICER 5662
6-SPEED TRANSMISSION

GEAR	Reverse	1st	2nd	3rd	4th	5th	6th
RATIOS	8.25	8.23	4.56	2.80	1.85	1.32	1.0





Direct Drive in 6th for High-Speed Engines

The New Model 5662 Spicer 6-speed transmission has direct drive in sixth, an 8.23 to 1 low gear ratio, a conventional shift pattern, and closer shift steps in top gears for more efficient highway performance. The top five speeds are fully synchronized for faster, smoother, no-clash shifting. Nominally rated at 375-400 lbs. ft. torque, the new unit is an ideal transmission for vehicles in the 60,000 GCW range.

Operators of trucks with 5-speed transmissions, particularly those with supplemental gearing who don't use all available ratios, will find the new Spicer 6-speed can eliminate the additional weight associated with such gearing.

The model 5662 6-speed teams up well with Spicer's newest 12″ two-plate, spring loaded clutch, and operates smoothly with Spicer's old reliables, the 14″ and 15½″ multiple lever, single-plate clutches. Cast iron case has standard SAE 6-bolt apertures for side-mounted PTO's. Case also adaptable for conventional overhead or remote control shifting.

For full information on the new Spicer Model 5662 transmission, write to Dana Corporation, Toledo 1, Ohio.

DANA Spicer

DANA CORPORATION

Toledo 1, Ohio

SERVING TRANSPORTATION—Transmissions • Auxiliaries Universal Joints • Clutches • Propeller Shafts • Power Take-Offs Torque Converters • Axles • Powr-Lok Differentials • Gear Boxes • Forgings • Stampings • Frames • Railway Drives

Many of these products are manufactured in Canada by Hayes Steel Products Limited, Merritton, Ontario

Circle 120 on Inquiry Card for more data

NEW PRODUCTION and PLANT EQUIPMENT

By C. J. Kelly
ASSISTANT EDITOR

FOR ADDITIONAL INFORMATION, please use reply card at back of issue

Modified Epoxy Adhesives

NEW one-component modified epoxy resin base adhesives that provides high impact, peel and bend strength and will not run or flow on vertical surfaces during heat curing operations.

These adhesives, designed for bonding structural, metal and plastic parts, maintain exceptionally high strength properties at service temperatures from —70°F to 200°F.

Designated as SCOTCH-WELD Brand Structural Adhesives EC-2086 and EC-2186, these paste-type adhesives each contain a latent hardner that eliminates the need of accurately weighing and mixing a hardener with the base resin at time of use. Both adhesives have an unlimited working life and will not harden until heat cured.

Being 100 per cent non-volatile, these adhesives are particularly useful for bonding impervious surfaces. This feature also enables the adhesive to be cured with only contact pressure, thus eliminating the need for elaborate and expensive high pressure fixtures. *Adhesives, Coatings and Sealers Div., Minnesota Mining & Mfg. Co.*

Circle 50 on Inquiry Card for more data

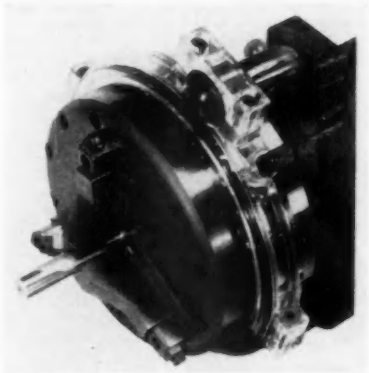
Air Coupling Device

THIS new air coupling unit has been introduced for use on chucking equipment with self-contained air cylinders. Called the Idler Air Coupling, the device is periphery controlled and air actuation is accomplished by inserting air through the cylinder wall. This design permits the center of a chuck to be open for through feeding of bar stock or for gaging equipment.

In the Idler Air Coupling Design the standard cylinder is replaced with a recessed cylinder which contains intake and exhaust air ports. An air supply ring with "O" rings on each side is clamped into position in the recessed cylinder.

A split clamp lobe on the idler ring is provided for alignment with a spherical joint to facilitate the attachment of the crank type support to the head stock of the machine. Air supply is connected with flexible hose.

In operation, after the work spindle is stopped, the air is turned on, and enters the air supply ring under the "O" rings blowing them out against the faces of the recessed cylinder.

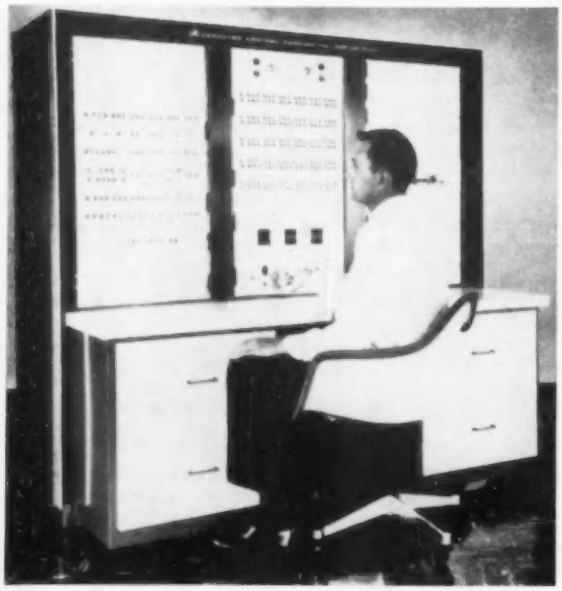


After air reaches the diametrically opposite sides, it enters the circular space under the air supply ring and from there enters the piston area through holes in the cylinder wall.

When the chuck is loaded and the air turned off, it escapes through the same passages. The "O" rings relax and rest clear in oversize circular grooves. *N. A. Woodworth Co.*

Circle 51 on Inquiry Card for more data

General-Purpose Computer Features Flexibility



This high-speed computer has been designed with unusual input-output flexibility. The machine is slanted toward solution of engineering problems, including real-time simulation, control of high-speed target precision tracking, and real-time test data acquisition. This solid state modular machine, known as the Digital Data Processor, has a 19 to 25 bit range. The first DDP computer developed was a 19 bit machine which utilizes a five microsecond, or 4 to 8 thousand core memory, with additional memory units available. Computer Control Co., Inc.

Circle 52 on Inquiry Card for more data

Ruby Grinding Wheel

MAN-MADE rubies are combined with a vitrified bond in a new type grinding wheel. The manufacturer reports the new wheel, after extensive tests, has proven to be very efficient and economical.

The new wheel is available in numerous styles and shapes. The Ruby wheel will perform a wide variety of work with few specifications, principally in 46 to 60 grit size in J grade of hardness.

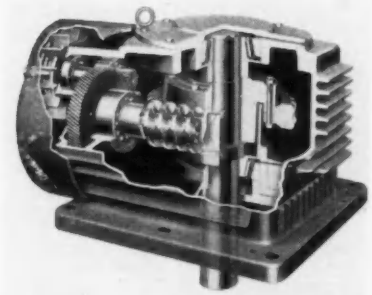
The "Ruby" element in the new wheel is a specially modified crystalline aluminum oxide abrasive. *Simmonds Abrasive Co.*

Circle 53 on Inquiry Card for more data

Speed Reducers

HIGH ratio worm gear reductions efficiency has been increased through the use of helical and worm gear double reduction combination in two recently introduced lines of speed reducers. The units are available with output shafts extending either upward or downward.

The helical and worm gearing run



in a large capacity common oil bath for lubrication and cooling. The two units have been named the HDF and the HUF speed reducers. The helical and worm gearing have both been designed to withstand momentary overload to 300 pct of rated load. *Cleveland Worm and Gear Div., Eaton Mfg. Co.*

Circle 54 on Inquiry Card for more data

Bed Gap Lathe

SWING of a heavy duty bed gap lathe has been increased in the gap to 49½ in. for added versatility.

New tailstock now standard on the lathe features two direct reading dials for measuring tailstock traverse. One dial records in inches, the other in thousandths of an in. The dials are resettable to zero at any point to facilitate subsequent reading.

Available new as an option will be two-speed tailstock traverse providing slower feed rate ideal for drilling, reaming or other tailstock operations, with standard feed rate affording quick withdrawal. Speed selection is by plunger control on tailstock wheel.

Another new optional feature is a revolving tailstock, featuring antifriction ball bearing quill, with locking device to lock quill for drilling or tapping operations. The revolving tailstock provides built-in accuracy comparable to spindle precision and incorporates a special device to compensate for heat generated in the workpiece during operation. The revolving tailstock is also available with two-speed feed. *Lathe Div., Nebel Machine Tool Corp.*

Circle 56 on Inquiry Card for more data

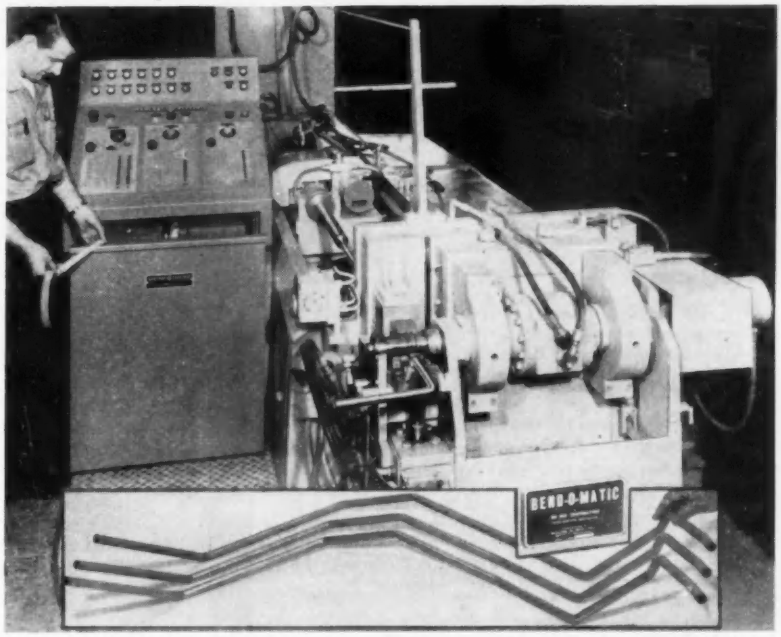
Newly Designed Air Dryer

Brazing, sintering, tool hardening, and general heat treating can be accomplished in a new open chamber furnace. According to the manufacturer this new unit has a new construction that makes possible fast temperature response and facilitates the maintenance of low dew points essential in heat treating tool steels.

Model DBB is the designation given the new air dryer. This unit has been built to produce effluent dew points of —85 deg F at air pressures of 100 psig. C. I. Hayes, Inc.

Circle 55 on Inquiry Card for more data

Tape-Controlled Tube Bending Machine



Insert shows typical example of precision bent tubing produced on new Bend-O-Matic

PRECISION tube bending operations can be performed on a new Bend-O-Matic metal tube bending machine. The machine was designed for precision tolerances required in many aircraft, missile and space vehicle tubing. An operator can hand-fit a piece of soft tubing through the various recesses and passages in a missile or airframe, measure the different bends and twists and transmits these measurements into the machine by pushing adding-machine-type buttons on a console. As the machine makes the first part it automatically punches a tape that can be used to reproduce as many parts like the prototype as necessary. The new unit will hold angles to plus or minus 1/20th of a degree, and distances between bends to 0.005 in. It will handle tubing up to 1¼ in. in dia and up to 8 ft in length. *Nu-Era Corp.*

Circle 57 on Inquiry Card for more data

Hobbs DUAL CIRCUIT PRESSURE SWITCHES

Add a NEW DIMENSION to Pressure Activation!

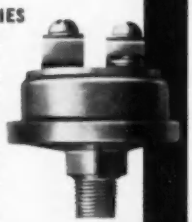
DOUBLE DUTY! Disconnects one electrical circuit while placing the other in operation. Industry-approved for a wide range of applications in dual circuit activation of various types of instruments, warning signals, safety devices, fuel pumps — in many other ways for making and breaking circuits. Ideal for locking out a starting motor while the engine is running. Can be used with oil or air . . . or with standpipe, almost any liquid or gas.

- **Non-ferrous pressure chamber**
- **Phosphor-bronze diaphragm**
- **Alloy contacts**
- **Preset at factory**

Available in pound setting specifications in both circuits within ranges of 3-6, 7-14 and 15-60 psi. Compact — only 1-11/16" diameter. Pressure assembled and pretested at 150 psi. Designed for use on direct current.

A COMPLETE LINE OF PRESSURE SWITCHES

Also available — a wide selection of single circuit pressure switches. Single terminal, double terminal, normally open, normally closed. Pressure ranges of 3-6, 7-14 and 15-60 psi.



Built by the manufacturers of Hobbs Running Time Meters and Shock-Mounted Head Lights. Distributors in principal cities . . .

WRITE FOR CATALOG PS605.

John W. Hobbs Corporation
A DIVISION OF STEWART-WARNER CORPORATION
2081 YALE BLVD., SPRINGFIELD, ILLINOIS

Symbol of SW Excellence

MANUFACTURERS' NEWS

Plastomer's Record Sales

Plastomer Corp. has been assured of the best sales record in its history when tabulation of its first three-quarters volume showed a dollar gross greater than for the entire 1960 year. The gain reflects development of new polyurethane foam products and additional productive capacity resulting from new processing equipment, Walter Baughman, president, said. He added that the growth pattern was substantially above the 22 per cent increase rate since Plastomer's founding in 1954.

Walter Lee, director of tire research and development for Goodyear Tire & Rubber Co., with the help of a double exposure, demonstrates a device that simulates the way tire cord pantographs—or changes angle—when a tire is molded. At right, the device is in the drum shape of a tire before molding. At left, it has assumed the shape of a finished tire. Mr. Lee had the device made to help explain tire construction to automobile engineers.

Parker-Hannifin Profits Rise

Parker-Hannifin Corp. earned a net profit of $690,580 on consolidated net sales of $13.4 million for the three months ended Sept. 30. This compares with $393,520 earnings on sales of $10.7 million for the same 1960 period. Earnings for the 1961 period were equivalent to 53 cents a share. The 1960 three-month earnings were 30 cents a share. C. C. Sigmier, board chairman, and S. B. Taylor, president, said they anticipated continued increases in both sales and earnings for the remaining nine months of the fiscal year.

Circle 121 on Inquiry Card for more data

UNILOY 435 STAINLESS STRIP

STRETCH BENDS SMOOTH AND BRIGHT

UNILOY
STAINLESS STEELS

Reduce or eliminate buffing and grinding! Uniloy 435 strip lets you stretch bend or deep draw to a smoother, more reflective finish.

A minimum-roping stainless pioneered by Universal-Cyclops two years ago, Uniloy 435 assures you of consistent and predictable results. It's an extra bright, straight chromium stainless, with physical and corrosion-resistant qualities similar to Type 430 grades. Its greater workability has been proved in plants throughout the country. If you have a roping problem, specify Uniloy 435 stainless strip.

Circle 122 on Inquiry Card for more data

UNIVERSAL CYCLOPS
STEEL CORPORATION
EXECUTIVE OFFICES: BRIDGEVILLE, PA.

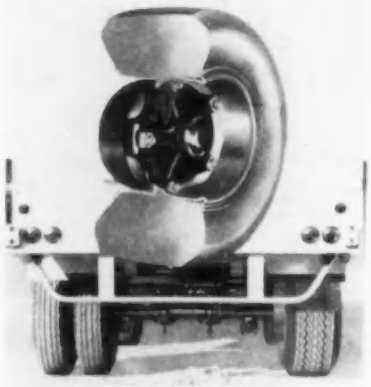
STAINLESS STEELS • TOOL STEELS • HIGH TEMPERATURE AND REFRACTORY METALS

NEW PRODUCTS AUTOMOTIVE · AVIATION

FOR ADDITIONAL INFORMATION, please use reply card at back of issue

By C. J. Kelly
ASSISTANT EDITOR

Cast Steel Spoke Wheel



A new cast steel spoke wheel has been developed for the large single tire. The new wheel has been designed to accommodate a demountable rim. A main feature of the new design is that it will encompass positive alignment. Kelsey-Hayes Co.

Circle 60 on Inquiry Card for more data

Air Filter Media

Air filters incorporating a new principle in self-cleaning using permanent filter media has been introduced.

Known as the Constant Flow Air Filter, the design assures a constant rated cu ft per min velocity by providing a continuously cleaned filter surface area unobstructed by impinged residue build-up. Depth filtration for extremely high efficiency can be achieved by the addition of up to two inches additional filter medium as a second filtration stage.

Basic advantages of the new filter are full, uniform air flow capacity throughout the entire filter area, smaller filter surface area requirement at a substantial reduction in filtration facility size and costs; in the elimination of filter media replacement costs and reduced maintenance labor. *Honan Associated, Inc.*

Circle 61 on Inquiry Card for more data

Ground Support Reels

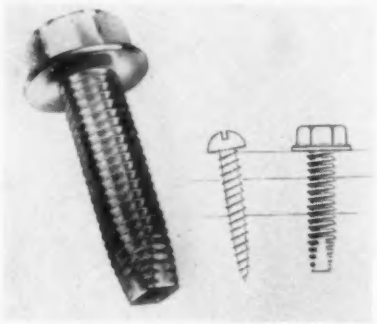
New retractable high pressure, all stainless steel hose and special multiconductor explosion-proof reels have been introduced for use in ground support systems and pre-flight testing operations.

Cables and hose are neatly stowed on the reels and are immediately available for check-out procedures. *Industrial Electrical Works*

Circle 62 on Inquiry Card for more data

New Type Fastener

Type S is the name given a new square nose fastener designed to start easy and drive straight. The type S is available in all standard sizes, finishes and head styles. According to the manufacturer the new fastener



has good friction qualities to prevent loosening by vibration. The fastener was developed for a wide range of applications in the various industries that use thread-forming and thread-cutting screws. It will use the same lead holes as most fasteners to eliminate new tooling. *National Lock Co.*

Circle 63 on Inquiry Card for more data

Silicone Rubber

Silastic 241U is the name of a new silicone rubber designed to meet the 40 durometer requirements of the following specifications: MIL-R-5847D class 2A and 2B, MIL-STD-417; Type T, class TA 405 B3 and E3, class TA 407 E3; AMS 3301 C.

Soft and non-tacky, the new material has good green strength, bands readily on mill rolls without crumbling and requires very little mill softening. Finished parts can be manufactured by molding, extruding, or calendering.

Suitable for use from −80 to 500 deg F, this material retains physical strength and flexibility after long exposure to temperatures in this range. Electrical properties are good and compression set is low. *Dow Corning Corp.*

Circle 65 on Inquiry Card for more data

Nickel Iron Batteries Get Power Boost of 77 Pct.

Electrical Capacities of nickel-iron alkaline storage batteries have been boosted up to 77 pct over previous models. The new design is said to match the capacity of some of the most powerful batteries designed to power electrical industrial trucks.

The new batteries produce electric current by the transfer of oxygen from the nickel oxide of the positive plate to the sponge iron of the negative plate, in an alkaline electrolyte. The plates have been redsigned to make more efficient use of available space. The plates can produce 100 ampere-hours per positive plate. They now produce 1.202 watt-hours per cu in., up from 0.68 watt-hour in the pervious design.

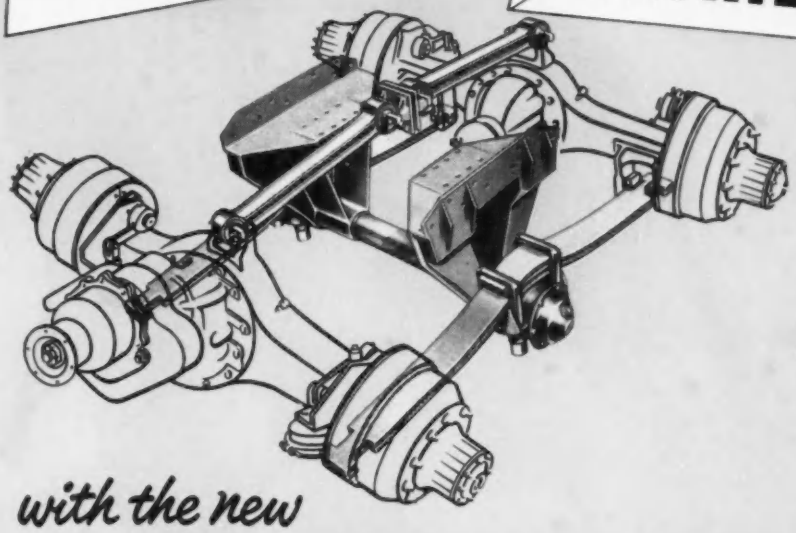
A feature of the new nickel-iron alkaline batteries is that their application to most existing electric trucks will not require alterations in standard battery compartments. The batteries are 22⅝ in. high.

Initially, the E line is available in five standard sizes—400 through 800 AH capacities, inclusive. This is adequate for trucks rated at to 8000-lb lifting capacities. Heavier duty models are planned. *Exide Industrial Marketing Div., The Electric Storage Battery Co.*

Circle 64 on Inquiry Card for more data

COMBINE

PAYLOADABILITY *with* RIDEABILITY



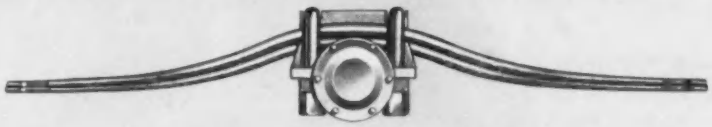
and get

- UP TO 434 LBS. MORE PAYLOAD
- A SMOOTHER RIDE LOADED OR EMPTY
- LESS WEAR AND TEAR ON TRUCK AND CARGO

with the new

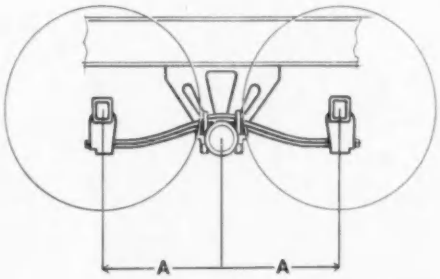
ROCKWELL-STANDARD TANDEM SUSPENSION

COMPLETELY NEW IN DESIGN... EXCLUSIVE "TAPER-LEAF" SPRINGS MEAN LESS WEIGHT— MORE PAYLOAD



It isn't the amount of spring steel but the way that it is used that gives strength to springs. With only *two* long tapered leaves in each spring Rockwell-Standard can achieve the same strength and load carrying capacity that standard suspensions can carry with multi-leaves...and at less than half the weight.

Optional aluminum frame support brackets and torque rods cut suspension weights by almost 25%.



BALANCED "CRADLE-RIDE" FOR SMOOTHER GOING—LOADED OR EMPTY

Balanced design with long resilient springs assures an easy buoyant ride and reduces vehicle hopping, pitching and swaying. Because of greatly reduced inter-leaf friction even slight road imperfections are absorbed. This shock absorbing action keeps vehicles tight, minimizes maintenance, reduces cargo damage and makes handling easier on or off the road.

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Transmission and Axle Division, Detroit 32, Michigan

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HEIL

This mark tells you a product is made of modern, dependable Steel.

United States Steel USS

USS Higher-strength steels make more sense for this rugged, lightweight trailer

(It carries 1700 pounds more)

Here is a high-capacity dump body trailer that gives you substantial deadweight reduction over a comparable carbon steel unit—for approximately $400!

An earlier trailer (see small photo) that went into service in January, 1961, hauling both hot and cold slag, had already proved that the proper combination of steels would create a lighter trailer with the extra payload costing only a few cents per lb. of weight saved.

To further prove our point, the second trailer, 24 cubic yards capacity, was built. Like the first trailer, "Experimental Unit #2" was created by the TEC Division of the Heil Company, Cleveland, Ohio, in conjunction with the Applied Research Laboratory of United States Steel. Using the USS Family of Steels—carbon steel, USS Cor-Ten High-Strength Low-Alloy Steel (50,000 psi minimum yield point) and USS "T-1" Constructional Alloy Steel (100,000 psi minimum yield strength)—compared to a 27-cu.-yd. capacity steel trailer, we were able to reduce the weight of this one by 1700 lbs.—resulting in an empty weight of only 8900 lbs.

Corrugated 16-gage USS Cor-Ten Steel was used for the trailer body sides, 12-gage in the floor, and USS "T-1" Steel in the high-strength draft arms.

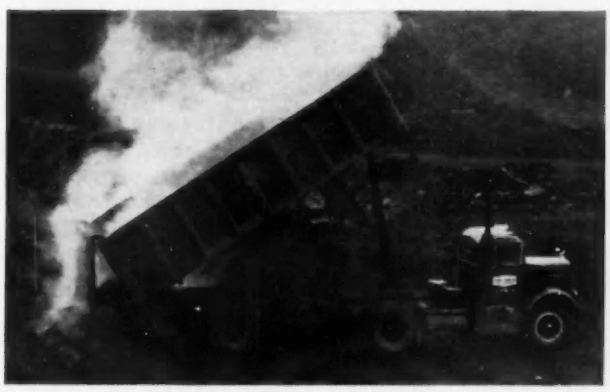
As a bonus, both USS Cor-Ten and "T-1" Steels give you four to six times the atmospheric corrosion resistance of carbon steel. You also get high resistance to abrasion and impact. USS Cor-Ten holds paints considerably longer than carbon steel.

In other words, pound for pound, higher-strength steels have yet to be equalled by any other material when you consider strength, endurance and cost.

For more information about USS "T-1" Constructional Alloy or our various grades of High Strength steels, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. USS, Cor-Ten and "T-1" are registered trademarks.

United States Steel Corporation · Columbia-Geneva Steel Division · National Tube Division · Tennessee Coal and Iron Division · United States Steel Supply Division · United States Steel Export Company

27-cu.-yd. dump trailer (Experimental Unit #1) has an empty weight of 9500 lbs. It easily withstood a punishing seven-month service test hauling 23,000 tons of hot and cold slag and is ready for several more years of grueling work. Operator: Hawkins Contracting Company, Pittsburgh, Pa.



METALS

Production and Shipments of Steel Expected to Improve in December. Users Still Ordering Steel on Short Term Basis.

By William F. Boericke

Steel Demand Holds Steady

While steel buying holds steady with no weakening in demand, some disappointment is evident that the operating rate has not increased faster thus far in the fourth quarter. Perhaps too much was expected. The auto strikes undoubtedly took their toll. It depends on whom is interviewed. Some mill executives are pleased with the outlook for December, others are a bit hesitant. But on balance, it is believed that production and shipments will improve in December, and there is universal belief that the first quarter will display a strong upturn. Almost all producers report they are getting new orders in greater volume for January.

By mid-November the actual operating rate was not exceeding 72 per cent of 1960 capacity. The slight decline that occurred early in the month was attributed to cutbacks by mills with heavy stocks built up when production ran ahead of shipments. But inventories are still at a low level and users still are ordering steel on a short term basis.

Buying Expected for Inventory Building

Yet it appears probable there will be considerable inventory buying of mill products within a few months as a hedge against a summer strike at the steel plants. In fact, some indications of this have already appeared. Auto makers will probably initiate such buying. One trade estimate is that 17 per cent of the first quarter shipments will go into inventory build-up. Consumers will be unwilling to get caught in a late spring boom with longer delivery time. Of course the danger of this is lessened by the present excess of mill capacity, of which consumers are well aware.

Steel warehouses expect to increase inventories moderately for the rest of the year, but stocks won't be inordinately high. A big pickup in deliveries as the fourth quarter opened failed to materialize, with the average size of orders low. Customer service requirements are exacting. The high cost of financing added stocks, and the ability of the mills to make fast deliveries, tend to keep warehouse stocks low.

Aluminum Demand Marks Time

Demand continues to improve, but at a slow rate. The prospect for an increase in fourth quarter sales is no more than fair, and won't meet earlier expectations. Nevertheless, total primary shipments have caught up with last year's volume and probably will end the year ahead of 1,900,000 tons. This gives considerable cause for satisfaction, because the entire gain arises from domestic demand, which is expected to show a 10 per cent increase over 1960 and overbalance the 56 per cent drop in exports, which fell during the first 8 months of the year from 285,000 tons to 91,500 tons.

It is not likely that production rates will increase until 1962 bows in. Operating levels for November were about 80 per cent of capacity. A tip-off on the attitude of the producers was the decision by Kaiser to cut its primary production from 90 per cent to 86 per cent, its reason being that its metal inventory had been built up to a level consistent with current sales. Kaiser's output has risen steadily since March, when its output was 60 per cent of capacity.

The main reason for the comparatively slow aluminum demand rests on consumers' belief that there will be no general price increase this year because of virtually guaranteed adequate supply of metal arising from substantial idle smelter capacity. Industry stocks have been cut about 40,000 tons since the first of the year, and equal about a 45 day supply at current shipment rates.

Zinc Deliveries At New High

Zinc statistics for October revealed a highly optimistic picture. Slab deliveries reached a 27-month high, and unsold stocks were slashed nearly 15,000 tons, bringing the total down to 150,000 tons at the end of the month, the lowest level since April, 1960 and only 6-weeks supply at the October delivery rate. The improvement occurred in spite of a 13,400 ton increase in output, as operations were resumed by American Zinc Co. after a long strike. The October figure brought total shipments for the 10 months of this year up to 770,500 tons, a sharp increase over the same period of 1960. Especially notable was the decline in stocks of Special High Grade, as die casters called for more metal to meet demands of the auto makers.

Lead Price At 15-Year Low

The depressed lead industry was hit in November by two quick price cuts that brought the lead price down to 10 cents a pound, a 15-year low. As so often happens, the first reduction of ½ cent merely served to scare off buyers and failed to stimulate sales. Weakness in London when the metal was offered at the equivalent of 7½ cents a pound was no help. The normal difference between New York and London prices is about 2½ cents a pound, made up of tariff and freight. The newest cut has not yet aroused much buying interest, but it seems unlikely that the price can go any lower. At 10 cents a pound

most domestic producers are losing money.

Copper Market Largely Featureless

Copper has held firm at 31 cents a pound in New York, and on the more sensitive London market it has stayed within the narrow range of 28½-29 cents a pound. Foreign sales rose substantially. The stronger tone probably reflects realization by traders and consumers that the Chilean mines may be struck again after the first of the year and that every labor contract in U. S. comes up for negotiation next June, when another work stoppage might follow in July. No doubt some hedge buying in anticipation may be seen after the first of the year. ■

Forging at Eaton

(*Continued from page* 50)

hearth. The manipulator carriage then withdraws, causing the unloader to deposit the heated billet on the press feed conveyor. The second phase operates just in reverse of phase one.

In all probability, by the time this article is in print, the final automation link for this complex will be in operation. At the present time forgings are transferred onto the power roller conveyors, seen in the foreground by the press manipulator, and move to the trim press. Added automation will take the trimmed forging from the trim press and load it onto a monorail conveyor. The latter will run in a path outside the building at the extreme right, transport the work for cooling, then will return to the plant area for unloading in the heat treating department.

Marion management is proud of a special Cargill-Detroit machine designed to straighten large axle shafts automatically in a fast cycle. Before this machine was acquired, they straightened shafts in the usual manner — manually in straightening presses. This machine has a fully automatic cycle, straightens shafts to better than specified tolerance—about 0.030-in. for axial alignment.

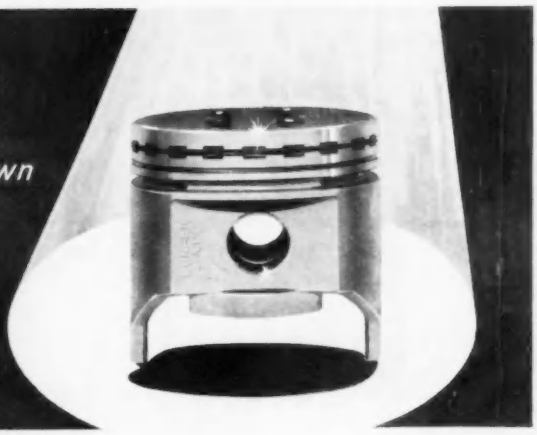
As illustrated, axle shafts are fed to the machine in a horizontal position. They are chucked automatically at one end, then the vertical hydraulic cylinder is actuated to deflect the shaft materially at its center while the shaft is being rotated. The amount of deflection naturally varies with the diameter of the shaft, and this is one of the minor adjustments to be made in machine setting when switching from one part to another.

As straightening is completed, the shaft rolls out of the machine onto rails and enters two automatic Drillunit stations of double-end type. The first station drills centers at both ends; the second station drills two driving holes on the flange end.

This piece of equipment typifies the drive for improved methods and advanced equipment wherever production volume warrants it. This one operation not only increases productivity, it improves quality and uniformity, eliminates a number of manually-operated stations, and releases floor space for other operations. ■

Sterling Piston in the Spotlight!

. . . and casting some light of its own on problems of the automotive industry.



For long range economy and peak performance, Sterling pistons have no equal. They are used by discriminating builders of engines for both passenger cars and trucks. But pistons account for only a part of our over-all production, which also supplies the aircraft, appliance, building, electrical equipment industries and other diversified items for the automotive industry.

In fact, with an annual capacity of 110,000,000 pounds of permanent mold aluminum castings, Sterling is ready to serve the needs of all industry through its decentralized midwestern plant locations.

Whatever your problems, we will give you complete engineering service and the fine quality control for which we've been famous for 40 years.

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By C. J. Kelly
ASSISTANT EDITOR

Brazing Alloys 1

Brazing alloy comparison chart lists AWS-ASTM designations, "Ambraze" alloys, and other manufacturer's tradenames; it also details all the important silver, copper and brass base alloys. *American Brazing Alloys Corp.*

Cams & Camshafts 2

A side range of cams and camshafts are portrayed in bulletin 210. Face and cylindrical cams; two and three dimensional cams; aircraft cams; master cams; hydraulic pump cams; cams for wrapping and packaging special machinery are graphically illustrated. *Eonic, Inc.*

Polybutenes 3

Polybutene characteristics and present and potential uses of this highly versatile petrochemical product are reviewed comprehensively in a new 31-page technical brochure. Titled "Oronite Polybutenes," the booklet describes typical applications within various areas of industry. Test tables and performance charts are included in the brochure. *California Chemical Co., Oronite Div.*

Fluidized Beds 4

Bulletin GED-4306A, four pages, is a completely revised publication describing a new heat processing tool, fluidized beds for annealing, normalizing, solutionizing, aging, hardening, quenching, and isothermal transforming. Cutaway drawings with callouts explain construction features. Ratings, dimensions and performance data are shown along with an over-all system diagram and catalog number listing. *General Electric Co.*

Machine Heads 5

A most comprehensive brochure covers heads for drilling, reaming, tapping and boring. This presentation suggests product application, explains the relation of heads to automation, and includes all drawings and tables required in basic production planning. Engineering principles are made clear through cutaways, enlarged pictures, and line drawings. All basic head shapes and sizes are delineated. All dimensions for all heads and spindles, respectively, are charted with accompanying keyed line drawings so as to facilitate reference work on the part of engineers using the brochure. *Zagar, Inc.*

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Hydraulic Motors 6

Variable displacement hydraulic motors featuring high efficiency and control accuracy are the subject of a new 4-page bulletin. Bulletin A-5238 describes the principle of operation, and covers performance from the standpoint of efficiency and control accuracy. For the latter, typical oscillograph traces show the response to step load changes. Specifications and dimensioned outline drawings are given for typical generator drive units. Data is presented on horsepower versus unit size for preliminary design purposes. *Aero Hydraulics Div., Vickers, Inc.*

Solid Lubrication 7

The theory and use of solid lubricants is discussed in a new eight-page brochure. Titled "Breaking Lubrication Barriers" the new brochure discusses such barriers to effective lubrication as galling and seizing, extreme pressures, high friction, chemical reaction, temperature and extreme environments, and describes how solid lubricants can overcome them. Actual applications describe how solid lubricants have solved difficult lubrication problems. The brochure is illustrated with photographs, charts, graphs and line drawings. *The Alpha - Molykote Corp.*

Bearings 8

Bulletin 7104, "Bearings," covers all sizes and styles of "Life-Lube" permanently lubricated, ball-bearing pillow blocks, flange units and take-up units as well as porous-bronze and babbitted pillow blocks. Newly published information includes a full page of babbitted bearing information on load ratings and maximum shaft speeds. New items in the catalog are two-hole flange units, offered in shaft sizes of from 1/2 to 1 7/16 in. Information is given in 12 pages. *T. B. Wood's Sons Co.*

Paint Striper 9

Literature on a new automatic air operated machine which, at a rate of up to 600 pieces per hour, and without masks or tape, simultaneously paints a stripe on both sides of vehicle tires or similar parts which can be rotated during finishing, is obtainable from *Conforming Matrix Corp.*

Reinforced Plastics 10

Reinforced plastics production methods are described in a completely new 16-page booklet entitled, "Guide and Data for Engineers and Purchasing Agents." Six basic molding procedures are discussed, together with advantages and applications of each, and tabulations present physical and chemical properties of parts produced by the different techniques. Methods described are hand lay-up, spray-up, preforms in matched metal molds, premix, prepregs, and filament winding. Proved production applications of reinforced plastics range from large pleasure cruiser hulls to heat-resistant missile and rocket parts, from rowboats to luggage, from chemical tanks to architectural panels. *Reinforced Plastics Div., The Society of the Plastics Industry, Inc.*

Attachments 11

12-page catalog G4A contains listings for a complete line of accessories and attachments for precision boring machines. This compilation describes fully the features, functions, and usage of fifteen varied tool and work holding, indexing, and positioning devices, and cycle assists. The text is supplemented with 27 illustrations of the items and typical applications. *Ex-Cell-O Corp.*

Dust Collector 12

An economical and highly efficient unit type dust collector designed to meet a wide variety of the air volume requirements throughout industry is described in bulletin 916. This four-page folder explains the versatile cloth filter bag dust control equipment—how it is made, how it works, its range of use and application, its special features and details.—*Pangborn Corp.*

Instruments 13

Forty-eight pages of information on instruments and systems for measuring, recording and controlling industrial processes. A typical product page in bulletin G-1a contains a sharp half-tone illustration, a clear, concise description with primary specifications, price range and literature reference. *Minneapolis - Honeywell Regulator Co.*

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Housekeeping 14

A new six-page pamphlet is available to industrial plants, food processing plants, and other business firms to guide their custodians in the best ways to use and care for equipment commonly used in housekeeping jobs. Entitled "The Tools of Housekeeping," the pamphlet discusses such equipment as mops, buckets and mopping outfits, vacuums, and floor machines. It gives easy-to-follow tips on: How to select the most efficient tool for each task, how to use equipment for best results without undue fatigue, how to clean, store and care for equipment. *Puritan Chemical Co.*

Pump Catalog 15

A complete expanded pump line is described in a new 1007-page Pic-A-Pump catalog now available. Engineering data are conveniently arranged for selection of centrifugal, axial or mixed flow pumps best suited to individual and specific applications. The information permits ready "engineering" of the pumping units and selection of the materials of construction needed. The Pic-A-Pump catalog is available on request on company letterhead from *Allis-Chalmers Mfg. Co.*

Instruction Manual 16

To assist users in obtaining optimum operation and longest service life, and to enable pump dealers and maintenance men to save time and needless procedures in installing, inspecting, and servicing its Holloshaft vertical turbine pump motors, U. S. Electrical Motors Inc. has just published a liberally illustrated and charted Instruction Manual covering its type HU Oil-Lubricated motors. *U. S. Electrical Motors, Inc.*

Cutting Oils 17

A new technical bulletin has been prepared on various types of specially formulated oil for improved performance and higher production in metalworking operations. Eight soluble oils make up a series of cutting oils offering the following advantages in metalworking operations: (1) superior lubrication between cutting tool and chip; (2) increased life for cutting tools and grinding wheels; (3) freedom from discoloration of the workpiece; (4) exceptional stability of the emulsion; (5) resistance to dermatitis and toxic effects on the operator; (6) minimum smoking and fogging of the cutting oil; (7) protection against rusting of the workpiece. The bulletin contains a guide to soluble oil selection and dilution rates for specified machining operations on steels, irons, alloys, aluminum, copper and copper metals. *Shell Oil Co.*

Crane Data 18

A six-page brochure illustrates and describes a new heavy-duty, standard crane available in capacities from five to 30 tons for Class D crane service. *Whiting Corp.*

Epoxy Resins 19

Four-page folder, with handy business reply card for ordering detailed information, compares 17 epoxy resins, their components, primary uses, handling characteristics, and physical and electrical properties. Material is in easy-to-read comparison chart form. *Mitchell-Rand Mfg. Corp.*

Cylinder Line 20

Bulletin SQ-61 is a completely revised and expanded catalog for the Squair Head Cylinder line. The literature comprises 48 pages of technical dimensions and engineering data on the entire cylinder line for 1½ thru 14 in. bore sizes. *Tomkins-Johnson Co.*

Welding Control 21

An 8-page bulletin describes a welding control which provides precise timing and transient-free operation for consistent, high quality welds. Describes application for spot, seam, and bench-welder control and special accessories available. *General Electric Co.*

View Gauges 22

New catalog features 168 view gauges covering a complete range of liquid-level gauges for use on gear cases, machine tools, oil reservoirs, hydraulic systems, pumps, filling machines, tanks and bins. The catalog introduces several brand new designs in this line. *Gits Bros. Mfg. Co.*

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Boring Bars 23

Charts, line drawings, photographs and specification information are included in a seven-page folder covering boring bars. Numerous types and styles of bars are covered in the literature. It also discusses features and applications for the bars. *Vascoloy-Ramet Corp.*

Grinders 24

Various types of grinders are discussed in a seven-page booklet. It covers types of machines and types of grinding wheels and discs along with specification data. *Gardner Machine Co.*

Investment Casting 25

A handy, pocket folder entitled "Quick Facts" has been made available for regular and prospective users of investment castings. It lists the major advantages of the lost wax process for producing machine parts from almost any desired alloy or metal. Included are tables for determining general tolerances, flatness, straightness, concentricity, roundness, accuracy of angles, hole positioning, keys and keyways, parallel sections, wall thicknesses, and surface finish values. The sequence of steps normally used in producing an investment casting is illustrated and described, and the back leaf of the folder has photo reproductions of actual parts made by this process. *Hitchiner Mfg. Co., Inc.*

Tool Tips 26

Special numerical control issue of "Tool Tips" is ready for circulation. It covers the many advantages of numerical control and discusses the saving that can be realized in companies not yet utilizing NC. *Ex-Cell-O Corp.*

Fasteners 27

"Imagineering" is the title of a publication which covers more than 80 specially designed fasteners and includes data on the design capabilities, fastener line and operations of a leading manufacturer. Principal line of screws, bolts, washers and rivets are also included. *Screw and Bolt Corp. of America.*

Stainless Strip

New 32-page, comprehensive, illustrated brochure provides a guide to correct selection of various stainless grades for specific applications. Data on the analyses, physical and mechanical properties, heat treating and finishing of 19 stainless steel types are provided, plus visual presentations of applications in the automotive, architectural, and other fields. General cleaning procedures for fabricated stainless products and weight tables are also included. Please write on company letterhead to this publication or direct to *Superior Steel Div. of Copperweld Steel Co., Carnegie, Pa.*

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SILICONE NEWS from Dow Corning

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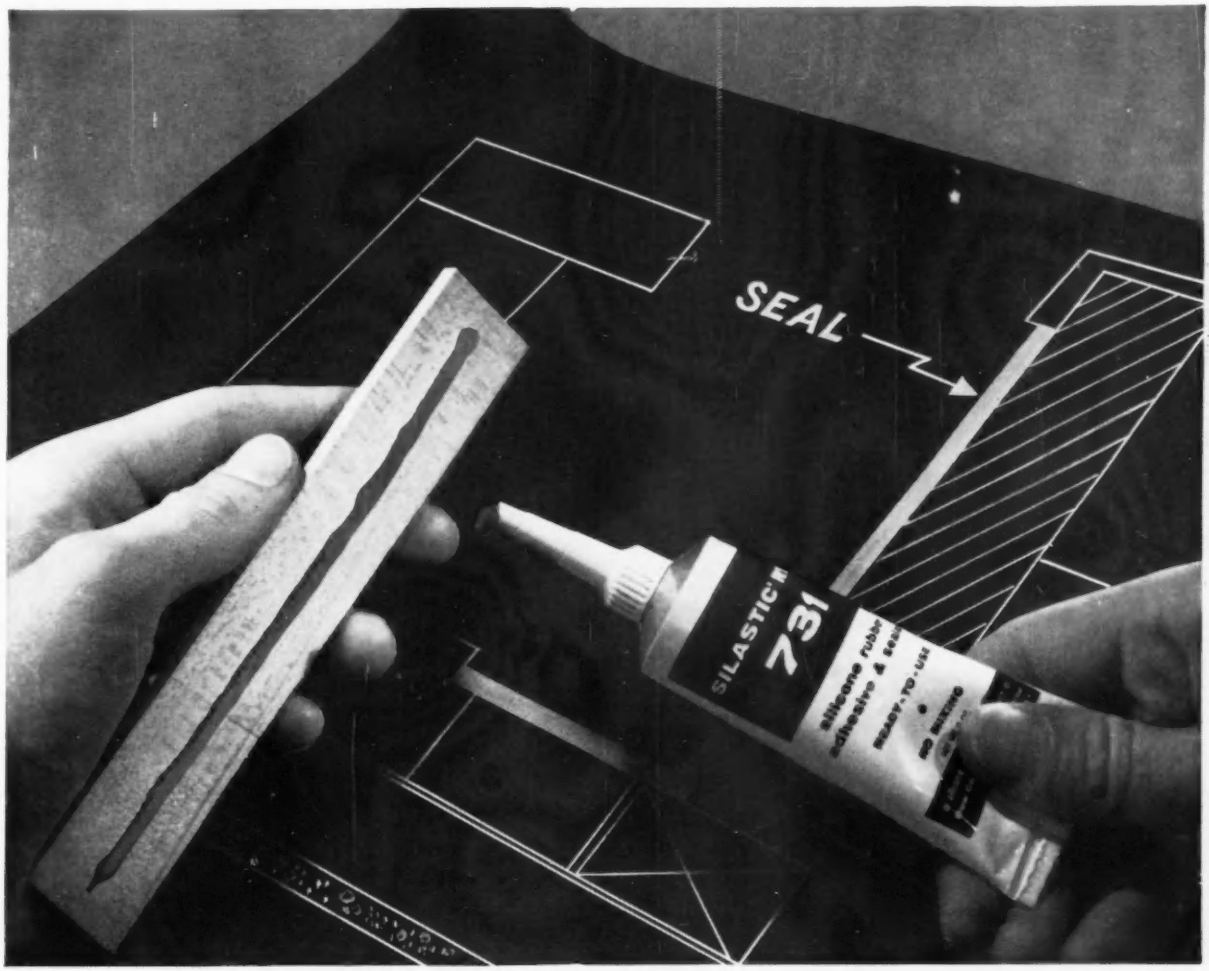

New rubbery adhesive seals out moisture, dust, contaminants

Here's a really durable, silicone rubber sealant that sets-up at room temperature and bonds permanently to most materials, including metals and plastics. Silastic® RTV 731 has the easy-to-use consistency of toothpaste and is supplied ready for application in handy tubes.

Silastic RTV 731 flows out smoothly, clings to most materials, won't sag or slump when applied to vertical surfaces. It quickly sets-up on exposure to air and cures *without heat* to form a tough, flexible silicone rubber seal.

Seals made of Silastic RTV 731 show no loss of either adhesion or flexibility when exposed to low pressure steam, moisture, high humidity or corrosive atmospheres at temperatures ranging from —100 to 500 F. This sealant offers solutions to all types of sealing and bonding problems. Wherever your blueprints call for sealing, it will pay you to look into Silastic RTV 731.

Write for "Greater Versatility with Silastic RTV." Address Dept. 1324, Dow Corning Corporation, Midland, Michigan.

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